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THE CITY OF LONDON ELECTRIC LIGHTING.

IT will be interesting to know how many, if any, of the existing electric light companies have sent in tenders for lighting the five districts into which the City area has been divided for the purpose of further electric lighting trials. Two of the districts are those formerly held by Messrs. Siemens Bros. and the Maxim-Weston Company respectively. This year contractors for the street lighting may obtain permission to run wires beneath the public ways into private premises during the term of the contract. We doubt very much, however, whether any electric light company would seek to avail itself, to any extent, of such a privilege, even on the supposition that the majority of the district residents are eager to take advantage of the opportunity of lighting their premises by means of electricity.

The inducements offered by the Commissioners of Sewers are anything but tempting, for the working term is to be for a period *not exceeding* five years from the *date* of contract being signed, and the Commission reserves to itself the power of determining the contract at any time after the expiration of *three months*, on giving the contractor four weeks' notice, in writing. Again, the contractor must provide all the necessary plant, and, at the expiration of the contract, which cannot last more than five years, but which may be determined in three months, he must remove this, and reinstate everything which he may have had cause to disturb, at his own cost. There is no intimation in the conditions issued by the Commission, that, in the event of a district installation proving successful, the City authorities would take it over at the expiration of the contract period. There are other conditions which we might call attention to did the circumstances warrant such a proceeding. As a matter of fact, however, so little interest appears to attach to the City electric lighting of 1884, that it is sufficient to barely mention a few points in connection therewith. Without knowing any particulars of the tenders which may have been sent in to the Commissioners of Sewers, we may safely assume that incandescence lighting will form no part of the street illumination, and that the public portion of the districts will, therefore, be dependent upon arc lamps. A correspondent writing to a contemporary assumes that only the Brush and Jablochkoff Companies are available for such a purpose, and he expresses his opinions in the following manner :—

"There is no valid reason whatever why the Brush system should be able to accomplish that which the Siemens, the Lontin, and the Weston systems have not been able to do to the satisfaction either of the public or themselves. The working conditions are identical in the four systems; same motor power and same number of men at the generating station; same or about same number of lamps of same character, all mechanical; and, no doubt, same number of outdoor attendants to keep in order the 'recalcitrant' lamps, this being really the stumbling-block of all electric light systems of the 'regulator' order. Between six and seven such attendants are required to watch a line of thirty lamps spread over a distance of nearly one mile—*i.e.*, about one man for every five lamps, each man receiving at least £75 per annum, a very low estimate considering the character of the duties; each lamp, therefore, costs on this head alone £15 per annum. It is easy to imagine that companies that are handicapped to such an extent cannot hope to do much good for themselves by undertaking contracts of this description.

"The Jablochkoff Company, it is well known, is *sui generis*, and alone is free from this expenditure. The simplicity of the system renders it possible to control almost any number of lamps from the generating station; and so it is that from twenty lights with which the Metropolitan Board of Works initiated the remarkable experiment on the Thames Embankment, the number has gradually been increased to fifty, covering a distance of over two miles without the addition of a single assistant to the original staff."

The writer carefully omits to state how many extra wires are employed in the latter system to enable the generating station to control the lamps. He is, doubtless, aware that the cost of insulated conductors is not an inconsiderable item in the expenses attached to an installation of electric lighting which covers a large area.

We feel compelled, although fully conscious of the merits peculiar to the Jablochkoff apparatus, to draw attention to this fact, in common fairness to the Brush method, and it may not be out of place to observe that the present satisfactory working of this system—the only one left to the City, by the way—sufficiently refutes the opening remarks made in the above extract.

With respect to house to house lighting, contractors have had, in this country, but little experience, the Edison system, as used on the Holborn Viaduct, being the sole instance; we will therefore defer to a more fitting opportunity any comments on this matter.

In conclusion, we think that those companies which have held themselves aloof from the invitation of the Commissioners of Sewers, have been well advised, unless, indeed, the termination of a contract for the street lighting does not necessarily imply the cessation of private lighting also.

REGULATION OF ELECTROMOTIVE FORCE.

WE published in our issue for December 29th, 1883, an interesting account of the electric lighting on board the United States Fisheries Commission steamer, *Albatross*. The writer of the article, which originally appeared at greater length in *Science*, spoke of the constant luminosity of the Edison lamps however many may be in or out of circuit, and he stated that this constancy was the result of placing an adjustable resistance in the circuit of the field-magnets of the machine, "whereby the internal and external resistances are balanced."

Mr. F. B. Crocker, in a recent number of our American contemporary, makes the following remarks on the subject :—

The reason an adjustable resistance is required in the field-circuit of an Edison dynamo, in order to maintain a steady incandescence of the lamps, results from the fact that the armature has some resistance. This resistance is quite small, to be sure, but it has a considerable effect, nevertheless.

In order that a multiple arc system should be perfect, so that the dynamo or generator would require no adjustment or regulation when lamps were turned on or off the circuit, it would be necessary that this generator should have absolutely no resistance; for, if it were possible to reduce the internal resistance to zero, then there would be no fall of potential within the machine itself; that is, the fall of potential would all be in the external circuit, and the difference of potential between the poles of the generator would be equal to the total electromotive force of the circuit. In that case, all that is necessary is to keep the electromotive force constant; and then it follows, that any number of the lamps in the system may be lighted or put out without producing any fluctuation whatever in the light of the other lamps, because the incandescence of a given lamp depends only upon the electromotive force with which it is supplied. Now, we know that the electromotive force generated by a dynamo is constant, provided that the speed of rotation of its armature, and the intensity of the field-magnetism are kept constant. The armature is maintained at a constant speed because it is driven by a steam-engine furnished with a governor, the function of which is to secure a constant speed; * and the field-magnets have a constant strength because the current which excites them is constant, since this current, like the current in the lamps, is produced by an electromotive force, which, by hypothesis, is constant.

Let us now consider the case where the resistance of the armature is not zero (to which, of course, it never could be reduced), but is some small fraction of an ohm (say, ·2 ohm), and suppose that there is a single lamp of 140 ohms' resistance in circuit, and that the electromotive force is 100 volts; then $\frac{140}{140\cdot2} \times 100 = 99\frac{6}{7}$ volts will be the fall of potential in the lamps, and only $\frac{1}{7}$ volt in the armature. But suppose that there are 70 lamps of the same resistance (140 ohms) in circuit, instead of a single one; then the external resistance will be reduced to $\frac{140}{70} = 2$ ohms, and the fall of potential in the lamps will only be $\frac{2}{2\cdot2} \times 100 = 90\frac{10}{11}$ volts, and $9\frac{1}{11}$ volts in the armature.

Thus we see, that, when the number of lamps in circuit is increased from 1 to 70, the difference of potential available in the lamps is decreased from $99\frac{6}{7}$ to $90\frac{10}{11}$ volts, a reduction of almost one-tenth; in consequence of which the candle-power of the lamps would be lowered at least one-third, and probably one-half. Of course, variations in the brightness of the lamps of one-third, or one-tenth, or even one-twentieth, would not be permissible: therefore, in order to maintain the required steadiness of the light, it is necessary to raise the electromotive force of the dynamo as more lamps are put on, and to lower it as lamps are taken off. This is done by increasing or diminishing the strength of current in the circuit of the field-magnets by means of a resistance-box interposed in the circuit. This regulation of the electromotive force of dynamos by controlling the resistance of the field-circuit may be, and in fact has been, made automatic; but up to the present time it has more generally been done by hand.

In what has gone before, I have said nothing about the resistance of the conductors which convey the current from the dynamo to the lamps. The effect of the resistance of any conductor which is *common to two or more lamps*—one of the main conductors, for example—is precisely the same as the effect of the resistance of the armature, which has been discussed above; but when a conductor supplies only a *single* lamp, then it does not have this effect. Of course there is a loss or fall of potential due to the resistance of the individual conducting wires of each lamp; and of course the fall of potential in the lamp itself, and consequently its brightness, are thereby reduced. But this resistance does not introduce any *irregularity;* its effect in diminishing the light of the lamps is constant.

Let us suppose that a conductor having a resistance of 140 ohms feeds a single lamp of 1·4 ohms' resistance; then the loss in this conductor will be 1 per cent. of the useful fall of potential. But suppose that we now put 10 more lamps in circuit: then the loss in the conductors will be increased to over 10 per cent.; and assuming the useful fall of potential to be 100 volts, with a single lamp in circuit, it will only be about 90 volts with eleven lamps. The candle-power of the first lamp would drop at least 25 per cent. or 30 per cent. when the other 10 lamps were added. Thus it is, that, in a multiple arc system of electric lighting, any resistance which is common to a number of lamps, whether in the armature or the conductors, causes fluctuations in the light of the lamps when other lamps are put on or off; whereas the resistance of the individual conductors of each lamp produces a loss of potential which is a constant fraction of the total potential, but does not introduce any unsteadiness.

* The speed would remain constant, but the *power* required would increase with the number of lamps in circuit.

ELECTRO-MAGNETS.

[A COMMUNICATION.]

THE BEST PROPORTIONS OF AN ELECTRO-MAGNET.

IN an electro-magnet there is a certain proportion of diameter of coil to (diameter of core and length of core), and also a certain proportion of length of core to diameter of core, that produces the greatest force with the least expenditure of energy. These proportions can only be determined by experiment, and since the diameter of the coil varies with the length as well as with the diameter of the core, the two proportions of diameter of coil to (length and diameter of core), and length of core to diameter of core, must be determined in two distinct sets of experiments.

To determine the diameter of coil best suited to any shaped core of an ordinary electro-magnet, the wire should be wound on a layer at a time, and the weight the electro-magnet will sustain, with a constant amount of energy expended in the coil, should be measured after each layer is wound on. The energy expended in the coil is proportional to the square of the current and the length of the wire (or its resistance); while the force which the coil will exert is nearly proportional to the square of the current and to the square of the length of the wire, when the wire is close to the core; therefore, when the electro-magnet has only a few layers of wire close to the core upon it, by increasing the length of wire and decreasing the current (so as to maintain the current^2 × resistance constant) the force of the electro-magnet will be increased; but after a certain proportion of diameter of coil to diameter of core has been reached, the force of the exterior layers of wire upon the core will, owing to their distance from the core, become so small that, by adding an additional layer of wire, the force of the electro-magnet will be decreased; this diameter of coil is the best suited to the core, and with any similarly shaped core this proportion of diameter of coil to diameter of core should be observed, whatever the size of the electro-magnet or the gauge of the wire with which it is wound. Having determined in this manner the proportion of diameter of coil to diameter of core in a number electro-magnets, having the same diameter of core but different lengths of core; then, that proportion of length of core to its diameter, which produces the greatest force with the least expenditure of energy, may be determined by measuring the force each electro-magnet exerts, when a current is circulating in its coils of a strength inversely proportional to the square root of the coils' resistance. These proportions once determined would give the proportions that electro-magnets should, always be constructed with, to be electrically the most efficient.

If an electro-magnet is provided with pole-pieces of any particular shape, the proportions of diameter of coil and length of core to diameter of core should be determined experimentally for each description of pole-piece, in the same manner in which the proportions of an ordinary electro-magnet are determined. Also, if the bobbin upon which the wire is wound is of different thickness with the same size core, then the diameter of the coil that produces the greatest force with the least expenditure of energy will be found to vary with the thickness of the bobbin.

LAWS OF THE ELECTRO-MAGNET.

The following laws are applicable to similarly shaped electro-magnets when the strength of magnetism is not near its saturation point.

(1.) *The current strength is the quantity of electricity that passes in unit time through a circuit.*

(2.) *The current's density is proportional to the current's strength divided by the sectional area of the circuit.*

(3.) *The current's volume is proportional to the length multiplied by the sectional area of the circuit.*

(4). *The amount of energy expended in sustaining a current is proportional to its volume multiplied by the square of its density.*

$$= l\,d^2 \times \left(\frac{a}{d^2}\right)^2 = \frac{l}{d^2} \times a^2 = \mathrm{R}\,a^2$$

(5.) *The strength of magnetism is the amount of magnetism within unit volume.*

(6.) *The amount of magnetism of an electro-magnet is proportional to the strength of its magnetism multiplied by its mass.*

(7.) The size of a magnetic field is always proportional to the mass of the electro-magnet, and the strength of the magnetic field to the strength of the magnetism of the electro-magnet.

(8.) *The strength of magnetism of the electro-magnet varies as the currents' density.*

This law is evident since both the strength of magnetism and density of current vary as the strength of current and number of turns of wire within the same space. Therefore, in different sized electro-magnets, when the current strength is proportional to the sectional area of the circuit, the strength of magnetism will be constant.

(9.) *The force which electro-magnets can exert is proportional to the (strength)² of their magnetism and to their mass.*

The weight a magnet will support is proportional to the force it exerts. The energy which is generated by rotating an armature in the magnetic field is proportional to the size of the armature (that is the size of the field) and to the square of the field's strength, and to a function of the square of the velocity of rotation. The energy generated by the rotating armature is therefore proportional to the energy expended in the coil of the electro-magnet, and to the square of velocity of rotation.

(10.) *The force an electro-magnet exerts is proportional to the energy expended in its coils.*

This law follows from (4) and (9).

(11.) *The force an electro-magnet exerts with a constant amount of energy expended in its coils, is proportional to the specific conductivity of the wire.*

(12.) *The strength of magnetism of an electro-magnet is proportional to the square root of the energy expended directly, and to the square root of the mass of the electro-magnet inversely.*

(13.) *The amount of magnetism of an electro-magnet is proportional to its (mass)½ and to the square root of the energy expended in it.*

To obtain the same strength of magnetism in similarly shaped electro-magnets, the internal and external resistances always being made equal, the following laws apply :—

(14.) *For equal masses the electromotive force should be proportional to the square root of the resistance of the circuit;* that is, the electromotive force should be proportional to the length of the circuit, since the length of the circuit would vary as the square root of its resistance.

(15.) *For constant circuit resistance the mass of the electro-magnet employed should be equal to the square of the electromotive force.* To maintain the same strength of magnetism the sectional area of the conductor must be proportional to the current's strength (and therefore to the electromotive force), and to maintain the same resistance the length of the conductor must vary as the sectional area, and therefore the mass that is (area) × (length) will be proportional to the square of the electromotive force.

(16.) *For a constant electromotive force the mass of the electro-magnet should be inversely proportional to the resistance of the circuit;* that is, the length of the circuit should be kept constant, and the sectional area varied as the mass. In this case the resistance would be decreased, and the current strength increased in proportion to the mass of the electro-magnet. It is evident, however, that it would be impossible to greatly increase the size of the electro-magnet, used with a constant electromotive force, for ultimately the sectional area of the circuit would become greater than its length.

(17.) If an electro-magnet has a constant number of turns of conductor, the resistance varies inversely as the dimensions of the electro-magnet, since the sectional area of the conductor increases as the square of the dimensions, while the length increases as the dimensions; therefore, with a constant current, the energy expended is proportional to the reciprocal of the dimensions, and the strength of magnetism varies as the density of the current, that is as the reciprocal of the square of the dimensions. *The force exerted is proportional to the reciprocal of the dimensions,* or to the mass multiplied by the square of the strength of the magnetism. The amount of magnetism will vary as the dimensions.

(18.) In each of the last four cases, *the mass of the battery (or other source of power) should vary as the mass of the electro-magnet.* The electromotive force of the battery varying with the length of the circuit and the sectional area of the battery as the sectional area of the conductor, the resistance of the battery will then always vary as the resistance of the electro-magnet.

W. MOON.

HOW TO MAKE A CHEAP VOLTAIC BATTERY.

EXPERIMENTERS engaged in electrical researches often feel the need of a convenient and cheap form of sulphate of copper battery suitable for testing and other like purposes. In case a considerable number of cells is required, the expense of the ordinary forms to be found in the market becomes quite a serious item. Such persons will be glad to know, says F. L. P., in the *Electrician*, of New York, that a very excellent, convenient, and inexpensive battery may be made from ordinary glass bottles of any convenient size. The accompanying illustrations show two cells of a series made from such bottles, 0m 065 (2·5 inches) in diameter and 0 115 (4·5 inches) in height to the shoulder, the contents of each being about 0·28 litre (half-a-pint).

The bottom of each bottle is first cut off, which may be done either in a lathe by the means of a glazier's diamond, or by putting a small quantity of water in a saucer or like vessel, and setting the bottle into it, with a little turpentine or other inflammable liquid upon the surface. By setting fire to the latter the heat will cause the bottom of the bottle to break off evenly at the surface of the water. As a safeguard against cut fingers the sharply broken or cut edges should be taken off by the application of a file or grindstone. Any required number of these vessels, as A, A, are placed in an inverted position in a wooden rack, B, B, formed of two thin boards placed one above the other, the upper one having holes cut through it large enough to admit the bodies of the inverted bottles,

while the lower one in like manner is provided with holes of a convenient size to admit the necks and thus support them firmly in an upright position. A cork, C, is inserted into the neck of each bottle, through which passes a stout copper wire, D, terminating above in a spiral of three or four turns, as shown at *d*. The whole should be made water-tight by the application of sealing-wax or other cement at E. The wire, D, from each cell is bent round and led through gimlet-holes in the rack as shown, in order to connect with and support the zinc element of the adjacent cell. For the size of cells mentioned, each copper wire, D, should be about 1m (3 ft. 3 in.) long, and No. 10 American gauge will be found a convenient size.

The zinc elements may be formed from rolled zinc plates 0m 0015 ($\frac{1}{16}$th of an inch) thick, more or less, which are first cut into rectangular pieces 0m 165 ($6\frac{1}{2}$ inches) by 0m 10 (4 inches), each of which, when divided, as shown by the dotted lines in fig. 2, will form two battery plates without waste. These are

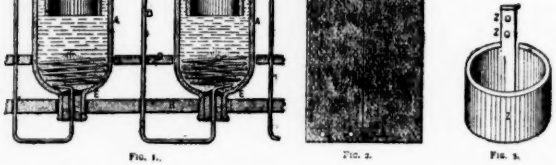


FIG. 1.

FIG. 2.

FIG. 3.

then bent into the cylindrical form shown in fig. 3, and small holes are drilled or punched in them, as shown, Z, Z, through which the free end of the copper wire, D, is threaded, as shown in fig. 1, the joint being made tight by hammering. This joint may be soldered with advantage, although this is not absolutely essential. The zinc plate may be more safely and easily bent by heating it. It should not be amalgamated.

The battery is set in action by filling the cells with soft water, preferably rain-water, after which a teaspoonful of pulverised sulphate of copper (blue vitriol) is dropped upon and around the copper spiral at the bottom of each cell. The action may be hastened, if required, by the addition of a tablespoonful of sulphate of zinc to the liquid in each cell.

This forms a practicable and convenient form of gravity battery for many purposes, and may be constructed by any one at a small cost. The cells may be of almost any required size, from that of a quart bottle down to an ounce vial, and the other parts in proportion. It will be found especially serviceable as a battery for testing purposes, or for operating amateur telegraph lines.

DELANY'S SYNCHRONOUS MULTIPLEX TELEGRAPH SYSTEM.

IN our issue of September 22nd, 1883, we published a description of a most ingenious adaptation of the "phonic wheel" of M. Paul De la Cour, for obtaining the synchronous rotation of two wheels at two ends of a telegraph line. This arrangement, devised by the inventor of the phonic wheel himself, is as perfect in its action as could be desired, and could not well be improved on. Mr. P. B. Delany, of New York, has recently taken the subject in hand, and has independently, and in ignorance, we believe, of M. De la Cour's invention, devised a method of obtaining synchronous rotations by means which differ to some extent from that arrived at by M. De la Cour. Mr. Delany has also applied his invention to a multiplex system of telegraphy, which in itself, however, is not, we believe, novel, nor is it, we imagine, really practical, except under very limited conditions.

The arrangement devised by Mr. Delany for producing the synchronous rotations of two wheels at two distant stations is shown by the fig.

In this fig. it will be observed that at station X three out of six contact points marked "9" are coupled together, and are in connection with a wire and battery, K, &c., and thence to earth. Three contacts also out of six, marked "10," are likewise coupled together, and are connected to the wire, Z, and thence through the electro-magnet, U, to earth. The remaining three intermediate 9's and 10's are thrown out or unconnected with any circuit. At station Y the 9's corresponding to those connected to the battery at station X are thrown out, while the alternate 9's, which correspond with those thrown out at station X, are connected with the battery, K^2; the 10's at station Y, which are connected with each other and with the electro-magnet, U, correspond with those which were thrown out at station X, the 10's at station Y corresponding to the connected 10's at station X being also thrown out or unconnected. At both stations the three 10's which are connected with the electro-magnets, U, U, are built out or extended toward the adjoining 9's, which are not connected with any circuit. When the trailing contact-arms, *f*, at both stations are moving synchronously, and rest on corresponding contacts, and on about the same portions of those contacts, the line will be in condition for telegraphic transmission. If the apparatus at Y runs a trifle faster than that at X, the finger, *f*, at Y will touch the extended side of a 10 contact, while the finger at X is still on a battery-connected 9, a current or impulse of electricity will then be sent from the battery, K, through the contact, 9, and finger, *f*, at station X, over the line and through the contact 10 and line, *l*, to the electro-magnet, U. When this takes place the relay, *U*, placed in that line is excited, and its armature is drawn down from its back stop, thus breaking the local circuit, *u*, and permitting the armature of a second electro-magnet, *V*, to rapidly pass to its back stop, and thus complete a shunt circuit, *v*, around the resistance, *S*, so as to cut it out of the tuning-fork circuit. The consequent increase in the current strength of the latter circuit that is thus momentarily produced, momentarily retards the rate of vibration of the fork, and consequently slows the rotation of the phonic wheel and the trailing arm attached to it, and causes the latter to drop back on its proper contact. The operation is the same at both stations.

Whenever the operator at either station hears the stroke of the relay, *V*, he knows that a correcting impulse has been received. By placing a relay and sounder, *W*, in the circuit of the correcting battery, at each station, between the 9 contacts and the earth, he can also tell when a correcting impulse has been sent out. No difficulty will be experienced, therefore, in ascertaining which of the instruments is slightly in advance of the other, but as long as any ticks or sounds are heard on the instruments on the correcting circuits, the instruments will be found to be in synchronism, since the variations possible are confined to a limit not exceeding one-fifth of the width of any regular segment.

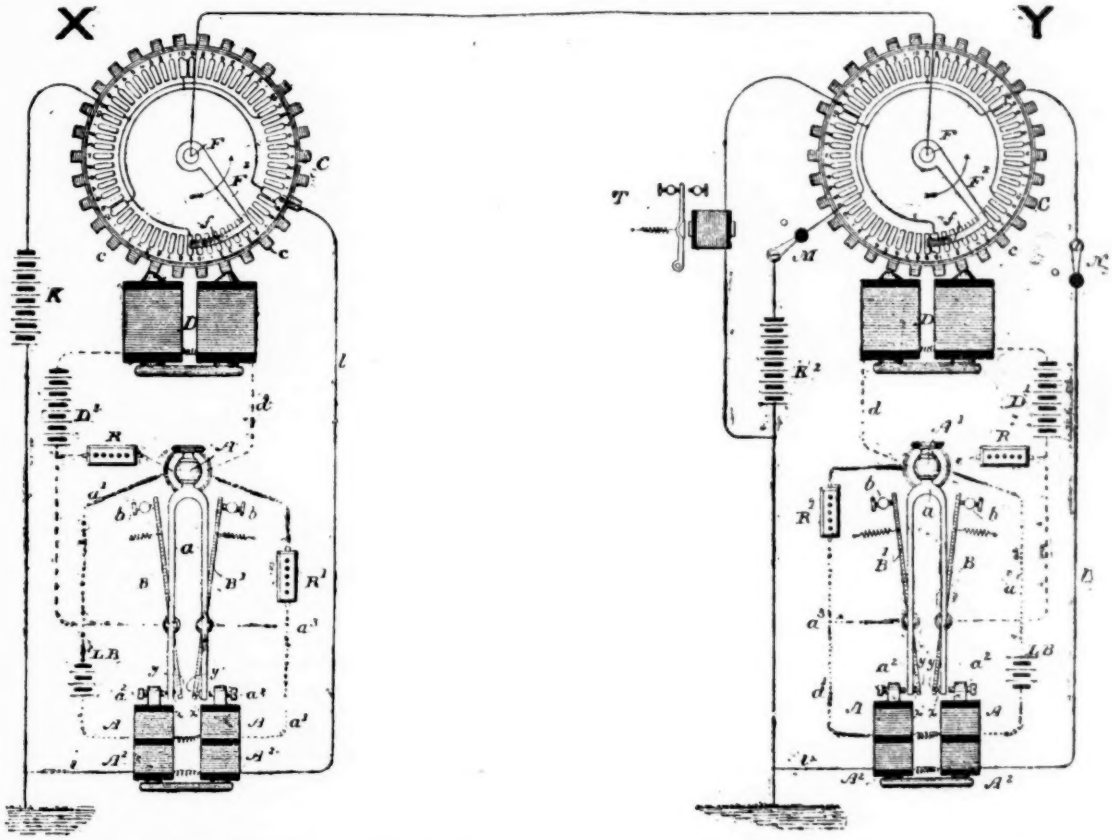
The apparatus is readily started by starting the fork and rotating the vertical shaft, *F*, and the adjustment of the two apparatus is completed at the other station, *Y*. At that station the operator also starts his apparatus, and closes the switches at *M* and *N*. By the means already described the operator at *Y* can tell which apparatus is running the faster, and he can then adjust his own apparatus so as to render the synchronising action to be as little needed as possible. The synchronism of the two will be rendered evident by the tell-tale strokes at *V* and *W*. It is found convenient in practice to make the resistance at *S* adjustable, so as to enable the amount of resistance normally included in the local circuit to be varied if required.

An important feature of the invention is the manner in which the correcting impulses are rendered effective when the relay, *U*, leaves its back stop, as the corrections are thereby rendered practically instantaneous; whereas, if they were not made effective until the armature of the relay had been drawn to its front stop

the action of the correcting device would be sluggish. The adjustment of the armature of the relay, *U*, is very delicate, and it therefore responds immediately to any correcting impulse; the tension of the spring of the relay, *V*, also is sufficiently high to enable its armature to move almost instantaneously to its back stop.

Should the trailing arm at one station be moving more rapidly than that at the other station, it must soon overtake the trailing arm at the other station, and bring them both into such relation to the battery-connected 9's, and the extended correcting 10's, that the correcting impulses will thereafter maintain them in practical synchronism.

Each tuning fork, *a*, is automatically vibrated by a local battery, LB, and magnet, A. The circuit of the local battery is marked *a'*. The cores of the vibrator-magnet are provided with extensions-screws, a^2, of magnetic metal, so that the poles of the magnet may be approached to or withdrawn from the prongs of the fork with great nicety, to regulate their rate of



vibration. On the inner faces of the prongs, platinum contacts, *x*, *x'*, are placed, which make and break contact with very delicate platinum contact springs of fingers, *y*, *y'*, which are carried upon adjustable insulated arms or levers, B, B', pivoted upon the bed plate of the apparatus. These arms are adjusted by thumb-screws, *b*, against which they are drawn by spiral springs, so that the platinum spring contact-pieces may be adjusted with great delicacy and firmness relatively to the contacts carried on the prongs of the fork.

The local circuit, which is indicated by the fine dotted lines, runs from the positive pole of the battery through the coils of the vibrator-magnet to the point, a^3. From this point the circuit runs to the insulated lever, B', contact-spring thereon, prong of the fork, head or support, A', of the fork, and back to the opposite pole of the battery. In order to prevent sparks between the platinum contact, *x'* and *y'*, a shunt containing a resistance, R', is run from the head or support, A', of the fork to the point, a^3, in the local circuit. When the fork is mechanically started into vibration, its local circuit will be automatically made and broken in the ordinary way, and its vibration be maintained continuously by the electro-magnet, A. The contact, *x*, on the opposite prong of the fork vibrates against a platinum spring contact-finger, *y*, on the insulated arm, B, and at that point, as the fork vibrates, makes and breaks another local circuit, which contains the battery and magnet which continuously rotate the transmission apparatus, C. This "motor-circuit," is indicated by the broken lines, and runs from the positive pole of the battery, D', to the lever, B, through its platinum contact-finger, *y*, the prong of the fork, *x*, to the head or support, A', of the fork; then, by wire, *d*, through the coils of the motor-magnet, D, D, back to the opposite pole of the battery. A shunt containing a resistance, R, is run from the head or support of the fork to the line of the circuit between the positive pole of the battery and the lever, B, to prevent sparks between the platinum contacts, *x*, *y*. When the fork is mechanically started into vibration, it will continue to vibrate automatically, and at each vibration will make and break the motor-circuit, and will alternately magnetize and demagnetize the cores of the electro-magnet, D, D, and will keep up the rotation of the phonic wheels in the well-known manner.

The contacts at the two stations are connected to sets of transmitting and receiving apparatus, in the well-known manner, each of the instruments coming into circuit successively as the arms sweep round on the contacts, so that *theoretically* a great number of instruments can be worked. It is stated that the intervals between the making and breaking of each circuit are so short as practically to be of little account, so that six Morse circuits can be properly worked at the most rapid speed attainable by the most expert operators.

The application of the principle, so as to work a number of instruments, on the A B C or type-printing principle is, we should imagine, quite feasible, as the movements of the instruments would be effected by the make and break action of the trailing arm; this, we believe, has been actually and successfully accomplished.

THE ACTION OF LIGHTNING STROKES IN REGARD TO THE METALS AND CHIMNEYS OF BUILDINGS.

(*Continued from page* 68.)

THE CHAIRMAN remarked that they had had a very full paper from Colonel Parnell, containing some revolutionary doctrines on lightning conductors. There were several gentlemen present competent to speak upon the subject, and in order to open the discussion at once he called upon—

Prof. G. I. SYMONS, F.R.S., of the Meteorological Society, who had been Secretary to the Lightning Rod Conference. That gentleman said his breath had been fairly taken away by the statements he had listened to. In fact, he could fancy he had been carried backward just a century, and he was not prepared to accept Colonel Parnell's opinion alone, lacking as it did the support of any great name. One thing in the paper appealed to their sympathies, and that was the large number of the cottages of the poor that were struck, and the great proportion of agricultural labourers killed by lightning. He thought that the explanation of the latter was, that they were generally at work in the fields, with some implement of iron or steel in their hands, exposing them to the effects of lightning. He could not account for the small houses coming out in the analysis as being most frequently struck, as his opinion was that because of their being low, they were much safer than higher objects. The tabulated cases of damage where conductors were fixed and where they were not, as given by Colonel Parnell, were not such as to draw correct conclusions from. He passed in rapid review the cases read, and pointed out that a reason could be assigned for each, either want of capacity, rusty joints, or bad connections, accounting therefor. In the case of the Nash Low lighthouse, officially reported upon by Faraday and quoted by the Conference report, Colonel Parnell had omitted the favourable evidence of Faraday, which was as follows :—"It is manifest that the discharge upon the tower was exceedingly powerful, *but the lightning conductor has done duty well—has, I have no doubt, saved the building.*" * Reference was also made to the worthlessness of conductors, such as was lately destroyed on Chichester Cathedral, where zinc was combined with the copper wires of the conductor. With respect to the protection suggested for the bottom of the chimney, he was not going to say it was a bad thing ; but he preferred a conductor on the outside of the chimney. If a connection were made to the earth, 12 inches was not enough, they must go down to moist earth. The Lightning Rod Conference had been composed of no one set of men, but was represented by the best individuals from the Meteorological Society, Royal Institute of British Architects, Society of Telegraph Engineers and of Electricians, and Physical Society, with extra members from the Royal Society, and they had done good work in getting valuable evidence of a reliable character bearing upon lightning conductors. That evidence was antagonistic to Colonel Parnell's views.

Prof. W. G. ADAMS, F.R.S., President of the Society of Telegraph Engineers and of Electricians, and President of the Lightning Rod Conference, next addressed the meeting. He thought that if Colonel Parnell had followed the course he had marked out, viz., for physicists to lay down theories and laws and then approach architects for the carrying out of those laws, he would have given a paper of a different character to that read. The Lightning Rod Conference report, he thought, might be taken as the concentrated efforts of the various societies, based upon evidence gathered with much care. In the matter of points, they had decided on a blunt upper point with a circlet of finer ones a little below. Out of 23 answers received by the Lightning Rod Conference, damage to buildings was reported in 16 cases where there were no conductors, and only six where conductors were fixed. In all the instances quoted of the lightning leaving the conductors for gas pipes, the line of least resistance was taken, showing in most cases a faulty earth. The area of protection was an undecided point, and one of the cases quoted would have required a protecting area of eight times its height to protect the part damaged, whereas about double the height of a conductor was considered the outside limit. Colonel Parnell says that the lightning discharge goes from the earth upwards, in opposition to what is generally accepted as coming down from the clouds to the earth ; but did Colonel Parnell know that when a discharge took place, as by Mr. Wheatstone's experiment with the Leyden jar, it met in the middle, giving the appearance from both sides of a sheet of paper of a burst outward. Hence, people were very likely to be deceived by a down-stroke leaving marks as of an up one.

Prof. HUGHES, F.R.S., also a member of the Lightning Rod Conference, confessed that he had learnt a great deal that night, to wit, that lightning and electricity were different in their action, whilst another interesting point was that there were no lightning strokes now, but there were a number of "thunder bolts." He desired very much to see one and get hold of it. To talk of buildings being destroyed by lightning because they were provided with lightning conductors was like talking of ships being wrecked by their rudders, or of steam boilers being burst by their safety-valves. If a ship had ever been wrecked because it had a rudder, it must have been because the rudder was wrongly used, or improperly attached to the vessel. It was also true that boilers with safety-valves had been known to burst, but that was when the safety-valves had been allowed to get out of order. In like manner, a lightning conductor was an element of danger to a building when its earth connection was faulty, or where it was non-existent ; but who that knew anything of lightning conductors, the purpose they were intended to serve, and the way in which they fulfilled that purpose, would think of fixing a lightning rod without providing it with a good earth contact ? To be effective, the earth-plate should in some instances cost more than the conductor itself.

Mr. JOHN SLATER, B.A., Member of the Royal Institute of British Architects, said he could not agree with the conclusions of the lecturer. Nor could he understand where his free electric taps on fireplaces were to take the earth's electricity to, as any attempt to tap the earth seemed like an attempt to empty the ocean of water. The suggestion that all metals in houses should be dispensed with to afford immunity from lightning, was alike unnecessary and impracticable. As an example of the silent action of lightning conductors in quietly dispersing electricity, he mentioned the town of Pietermaritzburg, which before the erection of efficient lightning rods was harassed by thunder storms, but since their fixing, was but little disturbed thereby. He, however, considered their thanks were due to Colonel Parnell for ventilating the subject.

Mr. SAMUEL VYLE, inventor of the "Patent Easily-tested Lightning Conductor," said, that as an associate of the Society of Telegraph Engineers and Electricians, he would like to point out that what Colonel Parnell recommended, in connecting the grates of the ground-floor with bars of iron driven into the earth, was practically advocating a lightning conductor proper, as the soot of the chimney with the warm current of air formed the upper part, which, however, generally terminated at the grate where, as a rule, stones or bricks insulated it from the earth ; but by connecting the grate to the earth, he completed the conductor. The same view was advocated years ago by Mr. W. H. Preece, F.R.S. (also a member of the Lightning Rod Conference), only he connected the grate, by means of a piece of conductor, to moist earth instead of having iron rods only a foot or so in the ground.

The CHAIRMAN said they had had a very interesting

* Lightning Rod Conference Report, p. 187.

discussion and he was sure that, at all events, the thanks of the meeting were due to Colonel Parnell for bringing the matter before them. It was a subject of importance, and the more it was ventilated the better it would be for all. A vote of thanks was very cordially given, and in reply, Colonel Parnell said he was obliged to Mr. Symons, Profs. Adams and Hughes, and Mr. Vyle, for their criticism. He scarcely expected that measures of the novel character he had suggested would be readily taken up. He only brought it forward as a student who had studied the matter some four years from societies' records and by examining actual cases himself. He had collected a certain number of facts, and it was more a question for their reasoning powers than anything else. What he had presented was mere food for reflection. His chief strength lay in the large number of cases.

The meeting then closed.

ON MEASUREMENTS OF ELECTRIC CURRENTS AND POTENTIALS.*

By Sir WILLIAM THOMSON, F.R.S.

IN this communication, after referring to the electrometer as being, when available, in one form or other, the most proper instrument for measuring differences of electric potential (inasmuch as it disturbs the difference of potential to be measured not at all, because the insulation of the insulated part or parts may be made practically perfect), it was shown that the functions of an electrometer can, for many practical purposes, in a thoroughly satisfactory manner be performed by means of a galvanometer of high resistance. Thus galvanometers, of from 200 or 300 to 30,000 ohms resistance, can be very conveniently used for measuring differences of potentials of from one to 600 volts, provided that in each case the coil is not heated by the current produced in it, so much as to cause more than allowable error by augmentation of its resistance. To obviate the need for a temperature correction on account of difference of atmospheric temperatures, it is necessary, for fairly satisfactory accuracy in ordinary practice, to have the coils of potential galvanometers made of German silver wire instead of copper. In cases, however, in which the sensibility obtainable by copper is desired, the galvanometer coils may be made of copper wire, but the proper temperature correction, amounting approximately to ·39 per cent. per degree centigrade, must be carefully applied.

But there is no need for the sensibility obtainable by copper coils in almost any of the practical applications of electricity except telegraphy; and for general use in scientific laboratories, or in electrical factories, or in connection with electric light installations, the potential galvanometer ought to have its coils of German silver wire, because the increase of resistance for this alloy is only about ·04 per cent. per degree centigrade, and is less than for any other known and practically available metal.

The author showed a new form of potential galvanometer, with four German silver coils acting on the two needles of an astatic combination hung by a single silk fibre. The astatic combination has for most practical applications great advantage over the single needle galvanometer in respect to liability to disturbance by magnets in its neighbourhood. The new form of astatic needle galvanometer, whether for current or potential, may be used even in close proximity to a dynamo machine without being sensibly disturbed. In this instrument the two needles of the astatic combination are controlled by two equal magnets or combinations of magnets, symmetrically arranged and adjustable for zero; but, in the instrument which the author prefers, not adjustable in respect to power. This last adjustment, which is used in one of the forms of the new instrument, has not been found very convenient and is, at present at all events, liable to suspicion of inconstancy. The method which the author at present prefers for adjustment to any desired sensibility, is by the use of adjustable resistances placed in series with the coils of the galvanometer. A very convenient and ready appliance of this kind, constituted part of a complete instrument shown to the society and designated by the author a Long Range Potential Galvanometer. After many years of trials and anxious thought, the author had come to prefer for practical purposes, the use of a standard Daniell cell to any other means hitherto realised for standardising a potential galvanometer. Accordingly he has made, to be used in connection with the new galvanometer, a convenient form of a standard Daniell cell.

A specimen of the cell was shown to the society. It consisted of a shallow rectangular tray of sheet copper about 15 centimetres square, and having vertical sides about 5 centimetres high. Within this tray is placed a zinc plate about 3 mm. thick and 14 centimetres square, supported firmly in notches of four wooden blocks resting securely in the four corners of the tray. In the centre of the zinc plate is a hole about one centimetre diameter, through which the stem of a filler, long enough to reach the bottom of the tray, passes, which is used to pour into the bottom of the tray a measured quantity of a saturated solution of sulphate of copper. The tube of the filler is very fine, and the capacity of the wide part is sufficient to hold the whole amount of copper solution, which is poured quickly into the filler and flows slowly out of it in the course of about a minute, so as to spread slowly over the bottom of the cell. The wide part is flat, so as to rest stably on the top of the zinc plate. To set up in action this cell a solution of sulphate of zinc of 1·02 specific gravity is poured into the tray so as to fill it as high up as the zinc plate, and by means of the filler the concentrated solution of sulphate of copper is poured in along the bottom of the tray in quantity sufficient to make a layer of half a centimetre deep.

The instrument without any resistance added to its coil, is of good sensibility for a single cell. In this condition its coefficient is determined. Then a very simple calculation or a table of numbers, tells the proper quantity of resistance to be added in order to give exactly the right sensibility with single divisions or round numbers of divisions, corresponding to single volts or round numbers of volts, according to convenience in the special application for which the instrument is wanted. The user can always, with great ease and with very little expenditure of time, standardise his own instrument in this manner by aid of a standard cell and standard solutions, which are supplied along with the instrument.

The pointer by which the deflections are read, consists of a light tube of aluminium with one end shaped to a fine edge by which the deflection is read on a circular scale, divided and numbered as in the author's graded galvanometers, according to tangents of angles of deflection. As in those previous instruments, the scale is of paper pasted on a horizontal mirror, by aid of which, error from parallax is avoided with great ease in taking the readings. To the other end of this pointer is attached about a centimetre of fine platinum wire, turned downwards so as to dip about a quarter of a centimetre below the surface of a large flat dish of heavy paraffin oil, with which a little olive oil may be mixed when more of viscous resistance than is given by the paraffin is desired. The author has found that thus a most satisfactory dead-beat effect is obtained, without any sensible error in respect to the position of equilibrium, whether for zero or for the deflection produced by a current. A properly shaped metallic pipette bottle, by which, when the galvanometer is to be moved at any time, the oil may be drawn off from the oil vessel with great ease, carried away without risk of losing any of it, and replaced in the vessel in the galvanometer, is supplied with the instrument. To make the galvanometer itself portable, the frame carrying the steel needles and

* Paper read before the Glasgow Philosophical Society; for illustration of voltmeter see ELEC. REV. for Jan. 19th, 1884.

pointer, which is hung by a silk fibre when the instrument is in use, is let down by aid of a screw so as to hang upon a brass pin passing through a ring which forms part of the framework. In this condition the instrument may be turned upside down or carried about in the roughest way, without the possibility of breaking the silk fibre. To set the instrument in action all that is necessary is to place it in position and level it, and by the screw pull up the upper end of the fibre to its proper position.

A current galvanometer with portable silk fibre suspension, oil vessel to give the dead-beat quality, astatic needles acted on by two circular coils in the main circuit surrounding the two needles respectively, and two magnetic systems of controlling magnets acting symmetrically on the two needles, was shown to the society. This instrument is in all respects exceedingly convenient for the practical measurement of currents except for the comparative difficulty of standardising from time to time necessary on account of the inconstancy of the steel magnets. This may be done electrolytically, with sufficient accuracy for most practical purposes, by weighing the deposit of copper from a solution of sulphate of copper, in the manner described at the end of chap. VII. of Mr. Andrew Gray's book, "Absolute Measurements in Electricity and Magnetism" (Macmillan: 1884). The process is, however, somewhat troublesome and takes a good deal of time. The standardising may be done with much greater ease by comparison with a standard current meter on the principle of Weber's electro-dynamometer. A very valuable and convenient instrument of this class, Siemens' well-known electro-dynamometer, with its novel and ingenious method for measuring torque by means of a spiral spring acting on the moveable coil or arc, which is suspended by a silk thread passing down along the axis of the spring from a fixed point above and has its two ends dipping in cups of mercury below in the same vertical with the bearing thread, was shown to the society.

Among the instruments shown to the society was also a Siemens' Watt-meter, which is the same as his electro-dynamometer, except that the fixed coil, instead of being of a small number of turns of thick wire in the main circuit, is of a very large number of turns of fine wire, connected by its two ends to two points of the main circuit, between which the measurement in watts of the electrical activity of the current is to be made. The moveable coil is of thick wire, and is, by means of its cups of mercury, joined in series with the main circuit. The instrument is an exceedingly convenient and valuable realisation of an idea which has, no doubt, occurred to many electricians,* but which, so far as the author knew, was first published by Prof. John Perry in the *Journal of the Society of Arts* for April 15th, 1881, as embodied in an instrument designed by Prof. Ayrton and himself.

The author remarked upon the great want which existed of a name for the unit of conductivity. He repeated a suggestion which he had made in his lecture on "Electrical Units of Measurements," delivered before the Institute of Civil Engineers in London, on 3rd May, 1883, that the name "Mho" might be adopted for the unit of conductivity corresponding to the resistance of one ohm. He showed to the society a new instrument which he had designed, and which he termed a Mho-meter. It illustrated the great advantages of using the conductivity method in many electric measurements.

This instrument is simply an astatic needle current galvanometer, with the steel controlling magnets replaced by coils of very fine German silver or copper wire, placed perpendicularly to the galvanometer coils proper. The two ends of the controlling coils are put in metallic connection with two points of a conductor, between which the conductivity is to be determined; this conductivity being exceedingly great in comparison with that of the controlling coils. The galvanometer coils proper are connected so that the whole current through them passes through the conductor whose conductivity is to be measured, except the small part of it which goes through the controlling coils. With these connections it is clear that the conductivity to be tested is equal to an absolute constant multiplied into the product of the conductivity of the controlling coils and the tangent of the angle of deflection. One main object of the instrument is to give a ready measurement of the conductivity of dynamo armatures and electric light mains, or of specimens of copper submitted for tests of their specific conductivity. For this application the controlling coils are made of copper, so that no temperature correction may be required (provided the temperature of the galvanometer is approximately enough the same as that of the conductor tested), and the instrument thus made may be called a "Copper Conductivity Meter."

When the object is to measure electric light currents the controlling coils are made of German silver wire, and are fixed in series with an adjustable resistance also of fine German silver wire, so wound in a convenient position in the base of the instrument as to exert no electro-magnetic force on the needles. In this instrument the conductivity of the controlling coils and of the resistance wire in series with them varies so little with the practical variations of temperature that the conductivity to be measured is for most practical purposes given with amply sufficient accuracy by the tangent of the deflection multiplied by an absolutely constant coefficient. The added resistance may be adjusted to make this coefficient such that one division corresponds to a mho, or a decamho, or a hectomho, or to any other value, within a wide range, which may be found convenient. It may, for example, be adjusted to give deflections at the rate of one division per lamp, and for this application the instrument may conveniently be called a "Lamp-Meter."

The author has such an instrument now in use on the lighting system of his house with varying numbers of from 1 to 40 Swan lamps, some of the old type 42 volts and some of the new type, but of only 84 volts (instead of the 110, which, of course, would be preferable if it were not for the old lamps which he has had in use for two years, and which he wishes to keep in use for as many years longer as they will last). It is beautiful to see the pointer moving up two divisions when a pair of the old lamps in series, and by one division when one lamp of the new type is lighted, and falling similarly when any number of the lamps are extinguished, and it is very useful to be able, merely by looking at the instrument, to tell how many lamps are lighted at any time. The inequality of the lamps gives scarcely an uncertainty of one lamp in the whole number when 30 or 40 are incandesced.

The potential galvanometer, which is also always kept on the mains, shows considerable inequalities (checked always, in the course of a few seconds, by the author's potential regulator, with its pair of mutually geared horizontal cog-wheels dipping on one side or the other, according as the potential is too high or too low, into a hollow centrifugal cylinder of oil rotating rapidly round them), but the pointer of the lamp-meter remains absolutely unmoved (or rather with absolutely no perceptible motion) throughout these inequalities.

* Prof. Perry, *Journal of Society of Arts* for 15th April, 1881; Sir William Thomson and Profs. Ayrton and Perry, British Association Report, York, 1881; and *Journal of Society of Telegraph Engineers and Electricians*, vol. xi., May, 1882.

A NEW YORK ELECTRIC LIGHTING STATION.

THE following particulars relating to the boilers, engines, and dynamo-electric machines in the principal station of the United States Illuminating Company will be welcome to many of our readers. The station is situated in Stanton Street, and it is regarded by the electricians who have examined it as a model of mechanical and electrical skill and practical efficiency. For the undermentioned details we are indebted to an article appearing in the New York *Electrical Review*.

From this one station there are 26 circuits. These

extend from the Battery to 99th Street—about 8½ miles. Lights generated by its engines and dynamos extend from the Hudson to the East River; they light up the Battery Park; Cortlandt Street Ferry, City Hall Park, and Washington Square. On the way up-town the United States Illuminating Company's lamps, are made to light up Broadway and Fifth Avenue, from the Stanton Street Station.

Sometime since the contract for the lighting of the great East River Bridge was awarded to the United States Electric Lighting Company.

The station proper consists of a building 58 × 100 feet. It is built of brick, with brown stone trimmings. The boiler-room is 54 × 47 feet. Near the partition wall, which separates the engine-room from the boiler-room, are two large chimneys which furnish the draft for the boilers. The flue in this chimney is 3 × 6 feet, and 100 feet high. After leaving this room one enters the engine room. On one side of the engine-room are located the engines, two in number. They are of the Corliss type, built by Watts, Campbell & Co., of Newark, N. J., and have given perfect satisfaction, and are peculiarly adapted to this class of work. The parts are admirably fitted, and all bearings and boxes are ground to their several places, thus making a very accurate, close working machine.

These engines drive a 7-inch steel jack-shaft, which revolves at the rate of about 175 turns a minute. The belt used on this shaft is 60 inches wide and 120 feet long. This is the largest belt in operation in the City of New York, and the largest but one in the world.

The power for the dynamos is received from intermediate lines, driven from this 7-inch steel jack-shaft. The belts used on these intermediate lines are respectively 36 and 42 inches in width.

The masonry supporting the fastenings of the 7-inch jack-shaft is put down to a depth of 10 feet, laid upon portland cement. Iron plates 4 × 5 feet on the top of this masonry support the boxes for the shaft. These are firmly bolted to the masonry beneath, and form a very substantial foundation.

There are eight horizontal steel boilers, 66 inches in diameter and 16 feet long. They were specially designed for this station. These boilers under a pressure of 85 pounds to the square inch, generate 125 horse power each.

In connection with the boilers, there is a Barryman heater which feeds them with water of a temperature of 200° Fahr. There is no loss of steam in this instance, as the water is heated by the exhaust or waste heat from the engine.

It is safe to say this type of the Corliss engine never appeared to better advantage than in this engine room, in charge of Mr. Campbell, the chief engineer.

It should be said that the large engine is nominally of 500 horse-power, but has been run up to 600. Its main fly wheel is 20 feet in diameter, 5 feet wide, and weighs 20 tons. The smaller engine is of 125 horse-power (nominal), but has easily run up to 200 horse-power.

On a run of fourteen hours, the large engine was ascertained to consume on the average, only 2⅝ pounds of coal per horse-power per hour.

The lower dynamo-room is 48 feet by 75 feet. Through the centre of the room there is a passage way, and on both sides are located the machinery and dynamos, thus giving free access to all parts which may require inspection. In this room and the larger dynamo-room overhead, there are 60 dynamos of ten, fifteen, twenty, and thirty lights capacity each. These rooms are in charge of the dynamo superintendent, Mr. A. E. Scoullar. There are two lines of dynamos above and below operated by the large engine; one line above operated by the small engine. The circuits from the dynamos and from the outside lines are all brought to a large and ingeniously constructed switchboard by means of which the dynamos can be coupled together in any way desired. Any outside circuits can be coupled together, and any of the outside circuits can be coupled to any of the dynamos, and changed in very quick time from one battery of dynamos to another, and without affecting the others to an appreciable extent.

The switchboard is also arranged so that the dynamos can be put on either engine. They can be readily changed from the night to the day engine. All the wires leading to this switchboard are encased in wooden mouldings in the ceilings overhead. This, besides being a very fine piece of joiners' work, results in keeping the wires out of the reach of careless or maliciously disposed persons. The machinery is so designed that, in case of accident to one line of shafting, another can be at once connected by a system of clutches.

The circuits are extended from the switchboard in regular order, so that the lamps may be adjusted to each circuit. These lamps can be taken out and put in without injury to the outside circuit.

The circuits are admirably arranged, being brought in and numbered from one to forty consecutively.

The switchboard, which was designed by Mr. E. A. Scoullar, is the most compact and most easily manipulated of its kind.

There is a testing-room in the building where all the lamps are tested upon the circuit in which they are to burn, and this department is under the personal superintendence of Mr. E. T. Lynch, Jr.

The machines used in the Stanton Street station, for both the arc and incandescent lighting, are of the same general type, the principal difference between them consisting in the winding of the armature and field coils, which is varied to produce the different qualities of current required.

The current generated by these machines is continuous, and free from pulsations, thus rendering it less dangerous.

In both the arc and incandescent systems, in the Stanton Street station, the regulation of the machinery is entirely automatic. Lights may be turned on or off at will, and a corresponding change is at once made in the current generated and in the amount of power required for driving the dynamo.

A marked peculiarity of the Weston arc system is the shortness of the arc or separation between the carbons, being about one-thirty-second of an inch in length, as compared with one-sixteenth to one-eighth of an inch in other systems. This enables a given number of lamps to be worked with a current of correspondingly low electromotive force.

From the Stanton Street station 576 arc lights are fed, and a large number of incandescence lights.

The Maxim lamp is used from the Stanton Street station, and it is said that in commercially operated plants the average life of these lamps has been found to vary from 1,500 to 2,000 hours.

The company is operating three other similar stations in the city; one on East 44th Street, one on Fulton Street, near Greenwich; and one on Elm Street, near Reade.

This vast business, says our contemporary, which has grown up in less than two years, is evidence, not only of business enterprise, but also of the merits of these systems of lighting.

ELECTRICITY v. GAS.

MR. OCTAVIUS E. COOPE, of Berechurch Hall, near Colchester, a gentleman within the remembrance of our readers, has forwarded the result of his experience with house-lighting by electricity to the *Times*. He says:—

"In the spring of 1882 I determined to go into the whole question of the best and cheapest method of illuminating Berechurch Hall. I first went into the gas question, which was, of course, easy enough, and then into that of the electric light, when so many difficulties presented themselves that I at once saw it would be both prudent and economical in the end to obtain the aid of independent professional assistance—a decision which time has fully justified the necessity of. After examining the various systems, I determined

to light the house with 200 Swan incandescent lamps of 18-candle power each; to employ four dynamos of the Burgin type, the steam-engine to be a 12-horse power nominal, with very sensitive governor and tubular boiler; and accepted the tender of Messrs. Crompton & Co. to supply the same, the whole work to be done in accordance with a regular specification and contract going into every detail, which I instructed my professional adviser (Mr. Musgrave Heaphy, C.E., of the Phœnix Fire Office) to draw up, with special precautions inserted to avoid danger of fire from fusion of the wires, short circuiting, &c., which is most important.

"The total cost of the electric light, every item of which I gave in a letter last year, including buildings, electroliers, fittings, &c., came to £1,470 8s., against £1,333 18s. for gas. But to the cost of the electric light I ought to have added £20 for stores, which will bring the amount to £1,490 8s., showing that the first outlay was somewhat in excess of what gas would have been. At the time I wrote my letter the electric light had been running about three months, and upon that working I supplied an estimate of the probable annual expense. I will give the figures over again in full, in order that they may be afterwards compared with the amount it has actually cost me.

"Estimated annual expense of the electric light, 200 18-candle lamps, each working 1,150 hours per annum:—Coal, at 20s. per ton, £38 10s. 1d.; engine-driver, at 30s. per week, £78; renewal of lamps, 153 at 5s., £38 5s.; depreciation, 10 per cent. on cost of machinery, £74; ditto, 5 per cent on conductors, £4; total, £232 15s. 1d.; or, say, one farthing per 18-candle power lamp per hour (the real figure being ·97 of a farthing).

"And now, before giving the actual cost for the year 1883, I must state that during the whole of the twelve months there has been no mishap of any kind, with the exception of the belt slipping three times, which caused five minutes' delay at the outside; and a little temporary trouble was occasioned by the drunkenness of the engine-driver, who had to be summarily dismissed. The lights have been steadier than gas, and they are as beautiful and brilliant as when the installation was first put up; nay, they are, if possible, more so, for instead of 18-candle power being given out, they are now working up to 20-candle power each, an increase of over 10 per cent. in the original contemplated illumination.

"When the installation was first put up, it was intended that the lights should run about the same number of hours per annum that they do here, viz., 1,150, but altered arrangements have required that the lights should be run for a very much longer period than previously determined upon, the actual working hours of the lights during the last twelve months having amounted to 1,823.

"I will now give the cost:—Coals (small, at 13s. 6d. per ton, mixed with coke, at 18s. per ton), £90; wages (engine-driver and lad), £79 14s.; renewal of lamps, 300 at 5s., £75; oil, cotton waste, &c., £20; repairs, £5 8s. 1d.; sundry small items and expenses, £7 16s. 8d.; depreciation, 10 per cent. on cost of machinery, £78; ditto, 5 per cent. on conductors, £4; total £359 18s. 9d., which is just under a farthing per 20-candle power lamp per hour (the exact figure being ·95 of a farthing).

"It will be seen, therefore, that in the estimate contained in my letter of last year, I overstated the probable expense. I have not only kept the installation in repair, but I have actually placed a sum by of £82, which annual amount will enable me, in less than nine years, to entirely renew the engine and electrical machinery, taking advantage of any improvements that may have been made in the meantime; or in the event of the machinery still being in good working order, to entirely recoup myself for its expense. My engine does a large amount of pumping, and I calculate that on this head alone it is saving me at the very least £60 per year.

"The renewal of lamps—300—may seem large, but there is little doubt that the late engine-driver, by his carelessness, weakened the carbon filaments of many of these, and caused them to break sooner than they would otherwise have done. However, this is an item I hope to see reduced this forthcoming year, and as time goes on to shrink into a very insignificant amount. I am also hoping to reduce the fuel charge, but it must be remembered that Berechurch Hall is about four miles from the nearest railway station, which is at Colchester.

"To those who are about lighting their houses, perhaps a few words concerning the manner I have distributed the lights so as to get the greatest possible illumination at the least possible cost may be of interest. Upon going into the matter, I perceived that the electric light was so very different from gas that it would be most wasteful to lay it out on the same lines. I therefore determined to have no 'bunching' of the lights but to keep each one as much as possible apart from the other. In no part of Berechurch Hall are there more than three grouped together, except over the billiard table. The majority of the lights are single, and in the hall and dining room they are simply suspended from the ceilings by silk cords, producing a charming effect, the lights appearing as if floating in the air."

ON A NEW METHOD OF GENERATING ELECTRICITY.*

By J. A. KENDALL, F.I.C., F.C.S.

AFTER referring to the researches of Deville and Troost, and the subsequent experiments of Graham on the penetration of hydrogen through red-hot metals, the author describes experiments which he made with a view to constructing a voltaic cell in which occluded hydrogen should take the place of zinc.

Cells were constructed by taking tubes of platinum foil, closed at one end, and connected with glass tubes by which hydrogen or other gases could be supplied to the interiors of the platinum tubes. Such a platinum tube could be held in the centre of an ordinary platinum crucible, which was intended for the other element of the cell. Various substances were fused in the platinum crucible at a red heat, and by connecting both the platinum tube and the crucible with a galvanometer by means of platinum wires, any generation of electricity could be perceived.

Several oxidizing salts were tried without success, but by using glacial phosphoric acid at a red heat the author found a distinct production of electricity when hydrogen gas was conveyed into the platinum foil tube.

The experiments being continued, it was found that a number of saline bodies in the fused state developed the electrical current with hydrogen, the chlorides of the alkaline and earth metals being quite as efficient as glacial phosphoric acid.

It was found that the platinum tube containing hydrogen acted like a zinc plate in a voltaic cell, but it appeared that the hydrogen, after passing through the saline medium, also passed through the walls of the platinum crucible, and it was then oxidized. In order, therefore, to get good results it was necessary to maintain an oxidizing atmosphere on the outside of the platinum crucible.

A more perfect apparatus was subsequently made for carrying out these experiments, and by the use of this apparatus numerous substances were tested as to their transmitting capacities for hydrogen. Vitreous matters, such as glass, were found to make much better media than the alkaline chlorides. Even porcelain and earthenware were found to transmit hydrogen at a high temperature, under the peculiar conditions of the experiments.

The use of glass as a medium made it possible to extend the researches in several directions, as oxidizable

* Abstract of Paper read before the Royal Society, Jan. 1884.

metals could be used in association with glass. The method usually adopted by the author was to take a glass tube of suitable quality, and to coat it internally with a metal, either in the form of sheet or as a pulverulent deposit. The glass was carefully fused on to this inner metal, whilst hydrogen was passed through the tube to prevent oxidation of the metal. Then the outside of the glass tube was usually covered with thin platinum foil.

On connecting the inner and outer metals with a galvanometer and heating to redness, while hydrogen was supplied to the inside of the tube, the electrical phenomena were obtained with great facility.

Nearly all metallic substances appear to be available for the internal coatings of these cells.

These effects were easily reversible if a reducing flame was applied externally, and air had access to the interior of the tube, as in this case hydrogen was supplied by the flame.

The quantity of electricity produced by this new method is proportionate to the amount of hydrogen diffusing through the apparatus; or, in other words, to the extent of metallic surface. The production of electricity also increases with the temperature. The electromotive force is, however, low.

It was found by the author that the vitreous matters used for the cells were practically non-conductors of electricity of low tension if access of hydrogen was prevented, although they became good conductors when hydrogen was supplied.

The second part of the paper describes experiments in which the hydrogen in flames gives rise to electrical currents by acting on arrangements of glass and metal. A rod or wire of metal such as platinum or iron was covered with fused glass, and the glass was overlaid with platinum foil. On connecting the two metals with a galvanometer, and heating the cell in a flame, a current of electricity could be produced, which was due to the withdrawal of occluded hydrogen from the inner wire or rod by the action of an oxidizing flame upon the platinum foil. Also a "reverse" current could afterwards be produced by the action of a reducing flame upon the platinum foil, hydrogen being then re-occluded by the inner metal.

An experiment is also described in which a continuous flow of hydrogen was maintained through a cell having a fused vitreous medium, by means of a Sprengel vacuum pump. In this case two concentric tubes of platinum were used, and the hydrogen was derived from a reducing flame, by which the apparatus was heated. The inner tube was connected to the Sprengel pump. By this apparatus a continuous current of electricity was produced.

The author also describes some experiments which illustrate the remarkable atomic force which hydrogen in flames exerts by reason of its great penetrative powers.

NOTES.

Electric Lighting.—As mentioned in our opening article, the electric lighting of the City of London for 1884 is to be tried in five districts. The streets lately illuminated by Messrs. Siemens, Bros., and the Maxim-Weston Company respectively, form districts 4 and 5. Number 1 comprises Giltspur Street, Smithfield (east side), Long Lane, and Aldersgate Street, from Barbican to Angel Street. District 2, Moorgate Street, London Wall, Blomfield Street, Liverpool Street, Old and New Broad Street, parts of Threadneedle Street and Lothbury, and Bartholomew Lane. District 3, Cornhill, Leadenhall Street, Aldgate, Fenchurch Street, Lombard Street, Gracechurch Street, and Bishopsgate Street Within (southern portion).

The large composing-room in the *Argus* office, Melbourne, Victoria, has been illuminated with the electric light. The light emitted is both soft and powerful, and strikingly superior, both as regards steadiness and brilliancy, to that given out by the gas-lamps which burn alongside. The current from which the light is derived is supplied from the central lighting station of the Australian Electric Company, from a new dynamo machine just finished. The machine is the largest in the Australian colonies, and is capable of supporting 600 lamps of 20-candle power each.

The offices of the *Irish Times* were fitted last week with the electric light on the incandescent system, nearly 200 Swan lamps being used throughout the premises. It is anticipated that the new light will give satisfaction, and that the temperature of the various departments, especially the compositors' rooms, will be more agreeable than when lighted by gas. The current is generated by one of Siemens' new type Alternating Machines, the novel feature in which is that the helix is composed of straps or ribbons of copper, instead of coils of wire, as in the older form of alternate machine. An upright shunt-wound dynamo is also used as an exciter, and at 1,500 revolutions the alternating machine gives a current of 180 amperes under an electromotive force of 45 volts. The machines are driven from a counter-shaft, the latter being coupled up with two 12-H.P. gas engines, so that one or other of the engines may be used at pleasure. The light, considering that the motive power is derived from a gas engine, is remarkably steady, there being no pulsation whatever visible in the lamps. Each lamp is provided with a switch, so that the light may be turned off or on as required. Safety plugs are also provided, which prevent too much current flowing through the circuit. The installation has been fitted up by Messrs. Siemens Brothers & Co. (Limited), under the personal superintendence of Mr. J. Angelo Fahie, of Dublin.

The electric light has been adopted at the Royal Hotel, Blackfriars. The large dining-room is illuminated by four of Siemens' arc lights, while the reading-room on the ground-floor, facing the Embankment, is lighted by Swan incandescent lamps. Twelve Swan incandescent lamps are also used in lighting the ladies' drawing room, on the first floor of the new wing, The electricity is produced by a Siemens' dynamo machine, driven by a 16-horse power "Otto" gas engine, which was supplied by Messrs. Crossley, Brothers. The whole of the arrangements have been designed and admirably carried out by Messrs. Siemens Brothers & Co. (Limited).

Mr. Hugh Watt, of the Maxim-Weston Company, writes to the *City Press* as follows:—"Will you allow me, through your columns, to state, in reply to numerous private inquiries, that we have no intention of again tendering to light an area of City streets upon rental, as, besides the following reasons, we are fully occupied with private contracts, &c. It is now nearly one and a-half years since negotiations were opened between the Commissioners of Sewers and this company, and I venture to state that the officials of no other company spent more time, nor took greater pains to meet, in all details, the views of the Commissioners, being then impressed with the importance of obtaining an extended City centre. Having maintained a City centre, with a large amount of plant and a competent staff, during all these negotiations, in a position to light up, within one month, several miles of streets, all in terms of our tender, I need hardly add that a heavy loss to us has been occasioned, and it at last became necessary for us to determine our contract, removing cables, lamp-posts, &c., so as to receive the large balance then payable in terms of the contract. It is futile for a moment to talk of companies undertaking lighting of the City upon rental, as where is the enormous amount of capital requisite to come from? When the Commissioners at last agree to the adoption of electric light on a large scale, paying for five times the amount of gaslight rather more than at present, in the interests of life and property in transit, I shall then be prepared to show them that, charging 3d. per arc lamp of 1,500 actual candles, and ¼d. per hour per household

lamp, that they will show a handsome margin after deducting all costs, and making every allowance."

The Anglo-American "Brush" Corporation has just issued a circular drawing attention to the merits of its electric lighting apparatus. We notice that the "Victoria" dynamo, embodying the patents of Schuckert, Mordey and others, which are the property of the corporation, is said to give a return in electrical energy of 96 per cent. It is also claimed that the 10 candle-power lamps manufactured by the corporation, are unrivalled in durability and uniformity. Attention is called to the "Brush" arc light machines, as the only dynamos in the market capable of running a large number of lamps in series. The "Victoria" machine is also recommended as being well adapted as an "exciter," which, says Mr. Wynne, the general manager, is an indispensable adjunct of the alternating current machine. Perhaps this gentleman is unacquainted with the Dandeu-Chertemps alternating current machine, which is self exciting. Altogether, we must say, that the circular does not err on the side of modesty, and until we see authoritative tests of the "Victoria" dynamo, we shall refuse to believe that the per-centage of conversion of mechanical into electrical energy is higher in this machine, than is the case with the Hopkinson-Edison. The same remark will apply with respect to the incandescent lamp of the corporation, as compared with those of Swan, Woodhouse and Rawson, and indeed several other types. On one point, we must decidedly agree with the Anglo-American "Brush" Corporation, viz.: in its endeavour to arrange for the periodical inspection of the dynamos and lamps which it has supplied.

Professor George Forbes, writing to the *Times* on the subject of Mr. Coope's letter (see our other columns), says:—Mr. Coope's experience of the difficulties in coming to a decision on the best way of lighting up a private house must be the same as that of nearly all who have attempted to act for themselves in the matter. One contractor will say that the series-wound dynamo has alone stood the test of many years' experience, another that the shunt-wound machine is the only economical one, a third that the compound machine is the one practical dynamo hitherto invented. He will be told that accumulators are essential, and again that accumulators are worthless. He will not know what kind of conductors, switches, cut-outs, and measuring appliances are necessary, and he generally finishes by selecting a contractor and putting himself unreservedly in his hands, unless he adopts Mr. Coope's plan of seeking independent professional assistance. In every case which has come to my knowledge where an installation of electric lighting, either in public or private trials, has been a failure, or has not given satisfaction, either in economy, regularity, safety, or efficiency, it has been due to the want of independent professional advice in the matter of drawing up a specification and in seeing that the conditions thereof are fulfilled. In the matter of private installations, this has been almost a universal experience, and among many public examples, I know of one company who contracted to light the streets of an important town and did not seek the opinion of their consulting engineer, a well-known electrician. The directors trusted to their own engineering knowledge and to that of their mechanical *employés*. As a consequence they had in the end to withdraw from the contract at a dead loss, which they put down at £10,000, but which was probably more.

The well-known firm of Messrs. Tangye Brothers, of St. Nicholas' Buildings, Newcastle-on-Tyne, has recently had a most successful installation of electric lighting on the Swan system carried out in their extensive premises. Like several other installations in this district, the work was entrusted to Messrs. J. H. Holmes and Co., who have, with the exception of the engine and boiler, supplied and erected the whole of the machinery and apparatus required, and who have had most of the elaborate fittings specially manufactured to their own designs. The machine used is one of Siemens' self-regulating dynamos, and is capable of running forty 20-candle-power lamps. The engine is of Messrs. Tangye's "Soho" type, mounted on the top of a "colonial" boiler, and this, together with the dynamo, is placed in the newly-erected warehouse, the machinery, when working at full power being quite noiseless.

A very complete description of the lighting of the Manchester Theatre Royal appears in this week's issue of the *Mechanical World*:—The engines and machines have been manufactured and erected by Messrs. Mather and Platt, of Salford. There are four Edison "shunt wound" dynamos employed, each one being capable of generating current for 250 lamps of 16-candle power. The lamps in and about the Theatre number 460, or thereabouts, of which 200 are grouped in the "sunlight," the remainder being distributed under the galleries, in the entrance hall, the passsages, the saloons, &c. The success of the installation is largely due to Mr. Ruddle, the engineer of the Manchester Edison Company, and to Mr. Watmough, the engineer of the Theatre. The two steam engines are so arranged that one is kept slowly running, whilst the other is developing its full power, so that in case of mishap to this engine, the other can be set to work at the full speed in a few seconds, and before the disabled engine has had time to pull up, They are run alternately on different nights, to keep each other in equal order. The whole installation, from the commencement of the drawings to the completion of the work, was executed within six weeks.

The Anglo-American Brush Electric Light Corporation, Limited.—The anxiously looked for annual report of this Company is at length issued. On another page will be found an almost full reprint of this report, but a few remarks on its contents may not here be out of place. It will be seen that the directors propose to cancel paid-up capital, *which is lost or is unrepresented by available assets*, to the extent of £5 per share, and to reduce the nominal amount of all unissued shares from £10 to £5. Speaking generally we quite think that this proceeding will be a judicious one, and especially do we hail with satisfaction the fact that the directors evince no desire to shirk, in the slightest degree, their difficulties. It is of great importance that patents, property and plant should always be represented at their minimum value, and that *full* allowance should be made for assets, such as the shares of subsidiary companies, which have a quite uncertain value. So far we welcome the apparent straightforwardness of the present directorate, but as some of the early directors are still at the board, we should like to ask why some of the now necessary reductions were not discovered before—for instance, further reduction of stocks (after £16,058 is deducted), of £47,190. In Profit and Loss Account No. 2, we think more details are very desirable, for therein we find only a single sum for manufacturing of £7,709, against (expenses and 10 per cent. depreciation) £32,875. The disproportion is enormous, and is the worst feature in the accounts. To arrive at a proper statement of the position of the Company is the right thing to do, and the getting rid, once for all, of any previous false valuation of assets, must commend itself to most people; undue depreciation is, on the other hand, to be avoided, for it would enable directors, in the near future, to pay a dividend which might simply of course be equivalent to paying it out of capital. We cannot see on the face of Profit and Loss Account No. 2, that there is much hope of a payment of a dividend, otherwise than as just indicated, for some long time to come, even on the reduced capital, and shall be glad to see at the meeting, soon to be held, that some shareholder has asked an explanation of this portion of the accounts. After paying a 100 per cent. dividend, what a contrast to reduce the share capital from £10 to £5. It is however, another proof of the truth of the oft repeated statement, that large *profits* are accompanied by great risks. That any gentlemen should remain on the board who had any share in the direction under Sir H. Tyler's presidency, may be considered by some, to savour more of audacity than

confidence ; and it certainly must appear to all a curious circumstance, that neither they nor their then colleagues were aware, of the necessity for *remodelling the system of book-keeping*, or, of the absence *of provision for fluctuation* in the value of a large part of their assets.

National Telephone Company, Limited.—The addition of between forty and fifty new subscribers in the Aberdeen district of this Company since September last, has rendered necessary the issue of a new list for that district. The subscribers' names are given numerically, alphabetically, and also under classified professional and business heads ; the progress of telephony in and about Aberdeen, being indicated by the wide range over which this Company's system extends, almost every variety of occupation being represented in the list.

American Telephone Companies.—The New York correspondent of the *Standard*, telegraphing on Sunday night, stated that :—" The stock of the American Bell Telephone Company fell yesterday from 180 to 145 within thirty minutes. Later in the day, upon the largest sales known taking place, it was quoted successively at 134, 145, and 160, and it closed at 152. The cause of these fluctuations was the prevalence of conflicting reports as to the decision in the case of the Bell Company *versus* the Overland Company. The fact is that no decision has been given, the court having reserved it, pending the decision in the case of the Bell Company *versus* the People's Company, which deals with fundamental points, and involves the question of priority of invention now disputed between Bell and Drawbaugh. The fluctuations measure the public estimate of the validity of Drawbaugh's claims, and their appreciation of the fact that his success would be fatal to the existing monopoly. If it was freed from that obstruction the telephonic art would enter upon a new era of world-wide usefulness. The financial bearings of the subject are, therefore, insignificant compared with its popular and scientific aspects."

The Metropolitan Brush Electric Light Company, Limited.—It will be seen by the circular which we publish in the "City Notes," that the shareholders' "committee of investigation" does not intend to let the grass grow under its feet. It has even gone beyond the powers conferred upon it, but we trust that the shareholders will support it in the petition, as only by vigorous action on its part can a proper investigation be brought about. If this is attained, our remarks of December will not have been in vain.

American Telegraph Companies.—A correspondent telegraphs from New York that the Baltimore and Ohio Telegraph Company has bought the wires and rights of the National Company, and says that the importance of this consists in the proof it affords of the steady growth of a competitor to the Western Union Company.

London and Provincial Electric Lighting and Power Generating Company, Limited.—The creditors of this company are required, on or before February 25th, to send particulars of their claims to Mr. W. L. Grimwade, 32, Queen Victoria Street, official liquidator. Wednesday, March 12th, at 12 o'clock, is appointed for hearing and adjudicating upon the debts and claims.

Jablochkoff Electric Light and Power Company, Limited.—A further petition has been presented for the winding up of this company, and will be heard by Mr. Justice Pearson, to-day. The petitioner in this instance is Mr. David Hulett, 56, High Holborn, a creditor.

The Tonquin Cable.—A telegram from the Eastern Extension Telegraph Company, announces that the steamer *Calabria*, having on board the cable for Tonquin, arrived on the 20th ult. at the mouth of the Hue River, in order to land the cable at Thuan-An, but the heavy sea prevented the operation from being carried out. A second attempt was to be made on the 23rd ult.

General National Exhibition, Budapest, 1885.—The prospectus and general regulations of the international section of this exhibition have been issued, and we learn that the term of application for machinery and implements has been extended to the end of April of the present year.

Personal.—The Emperor of Germany has been graciously pleased to make Professor Sir William Thomson, of Glasgow, a Knight of the Order *pour le Mérite* for Science and Art.

Muirhead's Duplex System for Submarine Cables.—The Paris correspondent of the *Times* says : "It is, perhaps, not known in England that there exists at this moment a contest between Messrs. Muirhead and the French Government, which is making use of Mr. Muirhead's system, and it may be hoped that the French Government will no longer persist in utilising so conspicuous an English invention without taking in future the unquestionable rights of the inventor into due consideration ; and that it will no longer despoil an English inventor of the fruits of his experience, and of those long efforts and sacrifices to which the telegraph owes the admirable Duplex system."

Companies' Shares.—The Stock and Share Advance Company, at their fortnightly sale on Thursday, found a difficulty in disposing either of the shares of the Indian and Oriental Electrical Storage and Works Company, or of the Electrical Insulator Manufacturing Company, the reserve in each instance being too high. The former, we learn, would have sold had 10s. been bid. South African Brush Electric Light and Power Company's shares fetched £1 each ; Maxim Weston Electric Company's, 4s. 6d. ; Electric "Sun" Lamp and Power Company's, 4s. 6d. to 5s. ; Gülcher Electric Light and Power Company's, 15s ; and Montevidean and Brazilian Telegraph Company's, 30s.

NEW COMPANY REGISTERED.

Jarman Electrical Company, Limited.—Capital £15,000 in £5 shares. Objects : To purchase the business of manufacturing electrical engineer, carried on by Mr. A. J. Jarman, of 25, Richmond Street, Bath Street, City Road, the purchase including the following letters patent, viz. : No. 563, 6th February, 1882, for arc electric lamps ; No. 2565, 31st May, 1882, dynamo-electric machines ; No. 2630, 5th June, 1882, dynamo-electric machines, and a patent for improved electric storage battery, containing six entirely new claims. The purchase consideration is £1,500 cash and £4,500 in fully paid shares. Signatories (with one share each): G. C. Hamilton, Leytonstone, Essex ; N. D. Sandwell, 10, Glenarm Road, Clapton ; E. Hutchinson, 8, Glenarm Road ; A. J. Jarman, 25, Richmond Street, St. Luke's ; N. Hutchinson, 15, Clapton Square ; R. Dunn, 38, Glenarm Road ; W. Williams, Leytonstone. The first directors are Messrs. Richard Cory, of Cardiff, and George Hamilton, of Leytonstone, qualification 50 shares ; remuneration, £250 per annum. Registered 28th ult., by Mr. Watson Smith, 6, Great Winchester Street.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

International Electric Company, Limited, formerly the Anglo-Austrian Brush Electrical Company, Limited. —The second return of this company, made up to the 14th ult., was filed on the 19th ult. The nominal capital is £500,000, in £5 shares. The number of shares taken up is 40,268. Upon 26,668 the sum of £3

per share has been called, 8,000 shares are considered as paid-up to the extent of £2 10s. per share, and 5,600 are issued as fully paid. The total amount paid up is £82,016 5s., considered as paid £48,000, and unpaid £1,987 15s. This return shows an increase of £21,833 5s. paid-up capital, as compared with the amount recorded last year. Registered office: 4, Copthall Buildings.

Sun Electric Light Company, Limited.—An order of the High Court of Justice, Chancery Division, dated 14th ult., states that the affairs of this company have been completely wound up, and directs that the books, papers, and documents of the company, other than the file of proceedings, be forthwith destroyed by fire, and that Mr. H. T. Edwards, the official liquidator, shall be at liberty to retain the sum of 4d., the unpaid dividend payable to Messrs. G. Waile & Co., creditors of the company.

Electric Brush and Appliances Company, Limited.—The office of this company is now at 116, Southampton Row, W.C.

CITY NOTES, REPORTS, MEETINGS, &c.

The Metropolitan (Brush) Electric Light and Power Company, Limited.

The following circulars have been issued:—

To the Shareholders of THE METROPOLITAN (BRUSH) ELECTRIC LIGHT AND POWER COMPANY, LIMITED.

Gentlemen,—In performance of the duties imposed upon us by the resolution of the 17th December, 1883, we have devoted much time to the investigation of the affairs of this company, and, after the most careful consideration, have come to the unanimous conclusion that it is not to the interest of the shareholders that the Holborn Provisional Order should be proceeded with.

Notwithstanding the representations of the committee and the demonstration to the board that the carrying out of the Holborn Order must, without doubt, result in a loss, instead of a "satisfactory return on the proposed outlay," as represented to the shareholders in the directors' report, the board have refused to give any undertaking to the committee to postpone, even temporarily, proceeding with the Holborn Order, upon the ground that the shareholders have, by passing the report, already adopted their policy, and thereby sanctioned the expenditure.

The committee are satisfied (and it is, indeed, now generally known) that the dynamos which formed the subject of the patents, for licenses under which the company paid £235,000, are such that they cannot be used alone so as to comply with the provisions of the Electric Lighting Act, 1882.

It would be necessary for the company to acquire rights to use other apparatus, and as these Brush patents formed the real basis upon which the company was formed, and the licenses under these patents were put forward to the public as the inducement to subscribe the capital, the committee are unanimously of opinion that the remaining capital so subscribed ought not to be called up and applied for the purpose of acquiring or working other inventions, unless upon the distinct vote of the shareholders approving of such a course being pursued.

The committee have carefully considered the question of the claim upon the promoters, and have come to the unanimous conclusion that a very strong case can be made out for compelling the promoters to repay to the company the whole, or a very large portion, of the £235,000 paid for the licenses; but they feel that it would be extremely difficult to enforce this claim except by the company being placed in a position to avail itself of the inquisitorial powers conferred upon liquidators under a winding up.

Under these circumstances, the committee have, after the most anxious consideration, come to the unanimous conclusion that it is absolutely necessary, in the interests of the shareholders, that prompt measures should be taken, and they have accordingly, through Messrs. Linklater & Co., filed a petition asking that the company may be wound up.

The committee feel that they may have exceeded the strict letter of the resolution appointing them, but, at the same time, they feel that it was really intended that they should protect the shareholders to the best of their ability, and have therefore not shrunk from taking the responsibility involved in filing this petition, in order to prevent the possibility of the promoters stifling inquiry by themselves getting a petition filed, and thus securing the appointment of their own nominee.

At the same time, the committee desire to inform the shareholders that they will complete their full report in the course of a few days, giving their reasons in detail for taking this course, and will at once issue it to the shareholders. They will also take steps to have a meeting summoned to enable the shareholders to pass such resolutions as the position of the company demands, and the petition which has been filed will be placed by the committee entirely at the disposal of the general body of shareholders, either to be proceeded with or to be abandoned, as may be considered most expedient.

In the meantime, the committee think it right to mention that it appears to them that under no circumstances is there any cause to induce shareholders to part with their shares at the absurdly small prices which have ruled in some of the transfers which have been recently registered, such as 1s. per share. There is no fear of a call *unless the policy of the board is re-endorsed*, and even should the shareholders resolve on winding up the company, there are at the present time more than sufficient assets to return a considerably larger sum than 1s. per share, with a very good prospect of a much larger return.

The labours of the committee have been heavy, and, they regret to say, have not been rendered lighter by the course which the board have thought fit to take, and which the committee will deal with in their report. In the meantime, the committee confidently appeal to the shareholders to take no step which will commit them to any proposition put forward by the directors, such as signing proxies in their favour, which may possibly be sent out with a view to forestalling the committee's report.

We are, yours faithfully,

ALEXANDER PEEBLES,
E. A. INGLEFIELD,
G. J. FREDK. ANDREAE,
LAWRENCE ENGEL,
} *Committee.*

London, *24th January*, 1884.

To the Shareholders of THE METROPOLITAN (BRUSH) ELECTRIC LIGHT AND POWER COMPANY, LIMITED.

Gentlemen,—You will remember that at the general meeting of the company, held on December 17th last, the policy of the board as expressed in the report was approved and adopted, and that a committee of shareholders was appointed "to investigate the affairs and prospects of the company, and the circumstances attending its promotion and formation, with full powers to call for documents, books and papers, examine the officers of the company, past and present, and to report the result of their investigations and recommendations (if any), to the shareholders as soon as practicable."

The committee, so appointed, have thought well to go beyond the powers entrusted to them, by taking the extreme step of filing a petition for winding up the company, and have issued a circular (dated 24th inst.), wherein they allege in support of this action, their opinion that a strong case may be made out against the promoters of the company for repayment of purchase-money, and that it would be difficult to enforce these claims except under liquidation. They also express the opinion that the carrying out of the Holborn Order must result in a loss.

The directors feel that the course taken by the committee is entirely mistaken in the interests of the shareholders, and that the opinion expressed in their circular as to the value of the Provisional Orders is based on insufficient data, and is at variance with evidence afforded by proposals for taking over some of these Orders on favourable terms, which are now under the consideration of the directors, and which would, as the committee were well aware, have been shortly communicated to them.

The committee refer to the report which they are about to issue in support of their circular, but the directors have no doubt of being able at the proper time to substantiate the soundness of their policy which does not necessitate a call as implied by the committee in their circular. The suggestion that, in order to carry out electric lighting work, it would be necessary to spend capital in acquiring inventions, or the right to work them, is quite extraordinary, and shows such a total failure on the part of the committee to grasp the most important bearings of matters on which they profess to speak only after the most careful and thorough consideration, as must deprive their opinions on these points of any weight.

For the present the directors merely desire that you would refrain from signing any proxies, and from pledging yourselves to any line of action until you have seen, not only the report which the committee are about to issue, but also the reply of the directors thereto.

An early opportunity will be afforded you of recording your vote and opinion on these matters at a general meeting of the company.

By order of the Board,
(Signed), ROBERT WILSON, *Secretary.*

110, Cannon Street, London,
January 28th, 1884.

Mr. T. Sanders, secretary of the Investigation Committee, writing to the *Standard* of Thursday, states that, until after the circular of the committee was issued, no communication of a trustworthy character was made to them by the directors in regard to the negociations to which the latter refer. Mr. Sanders says further that Sir Michael Kennedy, chairman of the board, three other members of the board, and Mr. Walter Webb, the solicitor to the company, have resigned their respective positions.

Gülcher Electric Light Company.

AN extraordinary general meeting of this company was held at the Cannon Street Hotel, on Friday. Our representative was refused admission to the meeting, the object of which, however, we understand, was "to reduce the capital."

The Direct United States Cable Company, Limited.

THE report of the directors for the six months ending 31st December, 1883, states that for the half-year the revenue, after deducting out-payments, amounted to £73,472 12s. 7d., against £77,469 8s. 3d. (after similar deductions) for the corresponding half-year of 1882, being a difference of £3,996 15s. 8d., against the half-year under review.

The working and other expenses, including interest on debentures and income tax, &c., amounted to £21,824 4s. 5d., leaving a balance of £51,648 8s. 2d. as the net profit of the half-year, making, with £1,852 7s. 11d. brought forward from the previous half-year, a total balance of £53,500 16s. 1d. For the corresponding half-year of 1882, the working expenses and other payments amounted to £22,786 3s. 2d.

Interim dividends of 1¼ per cent., each for the quarter ending 30th September, 1883, paid 16th November, 1883, and for the quarter ending 31st December, 1883, payable 16th February, 1884, together amounting to £30,355, have been declared.

The sum of £19,621 7s. 7d. has been set aside to the reserve fund (thereby increasing that fund to £340,000), leaving a balance of £3,524 8s. 6d., which has been carried forward.

An interruption has occurred in our short section of cable, which, however, does not affect the receipts, as the traffic passes by the alternative land line between Torbay and New York. The repair will be effected as soon as possible.

The Anglo-American Brush Electric Light Corporation, Limited.

THE report of this company runs as follows :—

1. The directors beg to submit to the shareholders the annual report and balance sheet for the year ended 31st December, 1883.

2. The shareholders are already aware that soon after the last general meeting, one half of the directors who constituted the board retired, and that in May last Lord Thurlow, the present chairman, and Mr. H. C. Gibbs, accepted seats at the board; and later in the year it was augmented by Mr. Edward Woods, Vice-President of the Institution of Civil Engineers.

3. One of the first duties that devolved upon the board as reconstituted, was to appoint successors to the late general manager, the secretary, and the engineer. They appointed Mr. Frank Wynne as general manager and engineer, and Mr. Emile Garcke as secretary.

4. The board found that considerable reorganization of the corporation's business was desirable, and it was also thought necessary, after a careful investigation of the books and accounts, to remodel the system of bookkeeping. An eminent firm of accountants, Messrs. Cooper Brothers & Co., have, at the request of the board, reported on the state of the books. In their report on the system of bookkeeping, as introduced by the new management, they state that they "consider that the new system of accounts in the office, and in the factory, is generally good, and apparently meets the requirements of the business of the corporation."

5. It was thought well to consummate this re-arrangement of the books of the corporation before issuing the balance sheet for the past year; and in submitting the latter to the shareholders, the directors, after consultation with counsel and with Messrs. Cooper Brothers & Co., have decided to deal with the accounts as hereafter explained, debiting profit and loss account with the various large amounts shown.

6. This course was chiefly rendered necessary by the fact, that in the accounts, as made up for 1882, no provision appeared for subsequent fluctuations in the value of those assets of the corporation, which were more or less subject to variation, and with a view to avoiding the results of the manufacturing operations being affected in future by circumstances not connected therewith, the board have decided to debit revenue account at once and for all time, with full provision for all such items as tend to uncertainty.

7. For these reasons the value of the whole of the shares held by the corporation in the subsidiary companies has been provided for. Some of these have been surrendered, but the corporation is still either possessed of, or entitled to, shares to the amount of £99,200.

8. The proposed adjustment also includes an amount of £51,632 10s., which is treated as paid under the settlement of accounts with Mr. Lane-Fox, but which is, for the most part, merely a reversal of items in last year's balance sheet. Other amounts augmenting the adverse balance will be explained later on, and are in chief the following :—Liquidation of accounts, £31,069 19s. 1d.; amount written off book value of stocks, £16,058 3s. 7d., and special reductions of stocks and patents referred to later.

9. It will be seen, therefore, even without further details, that the largest items in no way properly belong to the normal profit and loss account, being entirely outside the corporation's business for the year. In order that this large adverse balance may not stand in the way of the payment of dividends in future, and with a view to placing the corporation in a better financial position, the board recommend that such a reduction of the capital be made as will admit of the elimination of this deficit from the balance sheet.

10. The board have not only written off every doubtful asset, but have made the most ample provision for all contingencies, in the hope that this will free the balance sheet from any elements of uncertainty, and contribute to regularity in the payment of dividends in future.

11. The efforts of the board have been earnestly directed to freeing the corporation from the annoyance of expensive and vexatious litigation, and from all the misunderstandings affecting its relations with some of the subsidiary companies, and with Mr. Lane-Fox; and it affords the directors much satisfaction to be able to congratulate the shareholders upon the successful result of their negociations, which proved exceedingly difficult and protracted.

12. . . . . .

13. . . . . .

14. All allegations and charges made against the corporation by the Hammond Electric Light and Power Supply Company, in the matter of the "Lane-Fox" patents, having been unconditionally withdrawn and abandoned, as being unsustainable, the action brought by the corporation against that company, has been settled on a basis both honourable and satisfactory to the corporation. The result of the settlement is that certain apparatus, part of which was not in exact accordance with contract, is taken back by the corporation at net invoice prices, the Hammond Company contracting to re-purchase from the corporation apparatus to an equal amount. The Hammond Company have paid the corporation an amount in cash, and the remaining items of account have been adjusted. The various large money claims set up by the Hammond Company have been abandoned, and the directors are glad to say that good feeling has been restored between the two companies, and they look forward to a considerable renewal of business.

15. The shareholders will recollect that in 1882, Mr. Lane-Fox undertook to re-purchase from the corporation, for a sum of £50,000, certain patents, originally acquired from him, and known as his Distribution Patents. In part payment of this sum, the corporation was entitled to retain any sum due in account with Mr. Lane-Fox, which sum was estimated at nearly £14,000. Mr. Lane-Fox, however, maintained that a much larger sum was due to him, and cross actions were pending between him and the Corporation. As the amount payable to the corporation under the above-mentioned arrangement was a very large one, and as the corporation understood that Mr. Lane-Fox had not been successful in effecting a re-sale, upon the result of which he counted, to enable him to settle the claim of the corporation, and as moreover the corporation also considered that it would be an advantage to them to be in a position to release their licensees if necessary, from the covenant binding them exclusively to sell the "Lane-Fox" lamp, the directors deemed it advisable to enter into a compromise with Mr. Lane-Fox, whereby the corporation retained all monies due to him in their hands, and subject to the said existing rights of the corporation's licensees and purchasers, Mr. Lane-Fox took back his patents and agreed to grant the corporation a full and free license to manufacture, sell and use, and to permit their customers in the United Kingdom to use and employ all his inventions connected with electricity, and any improvements that might be made therein. He further undertook to pay to the corporation 20 per cent. of any profits which might accrue to him in respect of the sale or use of any of his patents until the corporation had received the sum of £20,000. In completing this arrangement the corporation agreed to transfer to Mr. Lane-Fox £14,000 in shares of the International Electric Company, and to make him a cash advance, in respect of which they have a first charge on all his electrical patents. The board feel satisfied that in making this settlement a tedious and costly litigation has been satisfactorily disposed of.

16. The action brought by the owners of the "Gramme" patent against the corporation in 1882, is not being actively proceeded with by the plaintiffs. On the contrary, the corporation have successfully applied for security for their costs, and unless the plaintiffs find the same, it may be anticipated that the action will be dismissed. Should, however, the action be proceeded with, the advice of counsel, most competent to form an opinion on electrical patents, is that the corporation need not be under any apprehension as to the result.

17. Beyond the action above-referred to, and two comparatively unimportant cases relating to alleged contracts of long standing for goods in dispute, the corporation are entirely free from litigation.

18. . . . . .

19. . . . . .

20. . . . . .

21. . . . . .

22. The called-up capital has been increased by £26,999, the amount of the call made in August last.

23. The total liabilities, including ample provision for all disputed claims upon the corporation, now stand at only £7,888 0s. 1d. In this respect the position of the corporation compares most favourably with the corresponding period of the previous year.

24. The value of the patents is shown at the figure to which it was reduced at the last general meeting, *plus* £758 16s. 10d., the amount paid for annuities during the year; and the directors propose that this asset be reduced to £25,000.

25. Property and plant stand at £57,082 19s. 10d., a figure which the directors consider represents a minimum valuation of this asset. The corporation's main works and offices in Belvedere Road are within the lines of limitation of the South Eastern Railway Company's Act, 1882, and they will, therefore, be sold to that company under the Act, if the widening of the line is proceeded with.

26. The stocktaking was carefully and minutely carried out in October last, involving a great amount of labour over a considerable period of time. It was therefore considered desirable and sufficient to arrive at the stock, on 31st December, by taking the result of the survey in October as a basis, modified by the receipts and issues during the last three months of the year.

27. . . . . .

28. . . . . .

29. As a result of the winding up of the Brush Electric Light and Power Company of Scotland, and of the Dublin Electric Light Company, the licences for Scotland and Dublin have reverted to the corporation, and on the other hand, the shares held by the corporation in the Scottish Company have been surrendered.

30. The next item "To liquidation of accounts £31,069 19s. 1d.," is the result of the liquidation and part relinquishment of sundry claims; the item also includes a large amount written off in respect of bad debts, and ample provision against loss in the remaining litigation and any possible contingencies.

31. The item "To amount written off book value of stocks, £16,058 3s. 7d." represents the deficiency between the value of the stock as per survey, and the value according to the ledgers, which is to be attributed to the former absence of proper factory books, and to the diminished value of certain electrical apparatus, of which a very large stock was manufactured in 1882. The directors propose that stocks be further reduced by 50 per cent., the extent to which this asset is considered at present unavailable.

32. The directors after consultation with the firm of accountants already mentioned, have set aside the amount of £99,200 as provision against the shares held by the corporation in the subsidiary "Brush" companies, and any variation that may hereafter occur in the value of these shares will not affect the amount rendered available for dividends as the result of the manufacturing operations.

33. Profit and Loss Account II. represents the net result of the year's operations. The directors regret that the great depression in electric lighting enterprise should have been of so long and unexpected duration. It is to be attributed to this unforeseen and uncontrollable state of affairs, and to the fact that the establishment charges during the early part of the year were unduly high that the account shows so large a loss. It includes, however, 10 per cent. for depreciation of plant and buildings.

34. The heavy loss shown is, however, no indication of the present position and future prospects of the corporation, to arrive at which it is necessary to compare the position of the corporation at the beginning of the year (when the charges and expenses were extremely high, and the business was from various causes much disorganised) with its position now. It affords the directors much satisfaction that their efforts to reduce the expenses and reorganise the business have been in the highest degree successful. The general charges are 50 per cent. less in the last quarter than they were in the first, and the economy effected in other departments is equally considerable;—*ex. gr.* while the volume of business during the last half-year has exceeded that of the first half by about 70 per cent., the amount of wages paid, and quantity of material consumed in manufacture have been relatively reduced.

35. In connection with this, the directors would mention that the removal of the incandescence lamp department, from Portpool Lane to the Victoria Works, is now on the point of being completed. The directors rely on this concentration of departments to effect a large saving, and inasmuch as the vacated building is situated in a very rising locality, the directors have every reason to believe that they will be able to dispose of the lease at a profit.

36. The deficit shown in the accounts is, as already explained, chiefly due to the manner in which the directors have deemed it advisable to deal with the shares in the subsidiary companies, to adjustments of accounts consequent upon the settlements that have been effected with Mr. Lane Fox and others, bad debts written off, and special reductions of stocks and patents accounts.

37. It will be impossible so long as this large balance remains to the debit of profit and loss account for the corporation to distribute as dividends, the profits which result from its manufacturing business: and the directors recommend, after a most anxious consideration of the position, that the shares of the corporation be reduced by £5 each. A resolution to this effect will be submitted to the general meeting.

38. If this arrangement is sanctioned, the corporation would be enabled to apply to the payment of dividends any profits, earned during the current and future years, in excess of the amount of £1,616 3s. 2d. to which the adverse balance would then be reduced; and the position of the corporation would, after the reduction of capital proposed, be briefly as follows:

Dr.	£	s.	d.	*Cr.*	£	s.	d.
Capital, viz. 13,701 shares £5 each fully paid	£68,505			Patents..	25,000	0	0
26,999 shares at £5 each, £3 paid	80,997			Plant and buildings ..	57,082	19	10
	149,502			Stock	47,190	1	3
Less calls unpaid ..	1,225			Debtors	21,043	3	9
	148,277	0	0	Cash	4,232	12	1
Creditors	7,888	0	1	Shares	99,200	0	0
Provision against shares ..	99,200	0	0	Balance	1,616	3	2
	£255,365	0	1		£255,365	0	1

39. The Board trust that this arrangement will, on reflection, meet with the approval of the shareholders, and in view of the profits which the Board confidently believe the corporation would then be able to distribute, they venture to express the opinion that the reduction of capital recommended would, if adopted, operate to the entire satisfaction of the shareholders. In the event of this recommendation being accepted by the shareholders, the Board propose that the holders of the shares, upon which £8 only have been paid, should have the option of placing themselves in a position of equality with the holders of the fully paid shares by paying off the remaining liability upon their shares in advance of calls, and thus enable them to participate fully in the future prosperity of the corporation.

40. The Board see every reason to anticipate a good and profitable manufacturing business in the future, and in support of this it may be pointed out that even if the present rate of business should not increase during the current year, the profits may fairly be estimated as sufficient to provide for a satisfactory dividend upon the reduced capital. In making this estimate the Board have taken the establishment expenses at the figure at which they now stand, although they rely upon being able to effect still further reductions.

BALANCE SHEET, 31ST DECEMBER, 1883.

Dr.	£	s.	d.	£	s.	d.
To CAPITAL:						
13,701 shares of £10 each, fully paid	137,010	0	0			
26,999 shares of £10 each, £8 called up	215,992	0	0			
40,700	353,002	0	0			
Less calls in arrear	1,225	0	0			
				351,777	0	0
To CREDITORS:						
Amounts due to sundry creditors, and provision for disputed claims	6,562	15	11			
Bills payable	1,325	4	2			
				7,888	0	1
To PROVISION against amount of shares in subsidiary Companies, per contra				99,200	0	0
				£458,865	0	1

Cr.	£	s.	d.	£	s.	d.
By PATENTS.						
Purchase price of patents, patent rights, &c., as per last balance-sheet	179,466	7	9			
Less amount written off December, 1882	132,950	0	0			
	46,516	7	9			
Add payments during 1883 ...	758	16	10			
	47,275	4	7			
Less proposed reduction (see report)	22,275	4	7			
				25,000	0	0
By PROPERTY.						
Value of plant and buildings, 31st December, 1882	66,491	1	10			
Less amount written off December, 1882	6,649	2	2			
	59,841	19	8			
Add payments during 1883 ...	3,583	11	3			
	63,425	10	11			
Less 10 per cent written off for depreciation	6,342	11	1			
				57,082	19	10
By STOCK.						
Goods manufactured, in process of manufacture, and materials at Works	94,380	2	6			
Less proposed further reduction (see report)	47,190	1	3			
				47,190	1	3
By DEBTORS.						
Amounts owing to corporation by sundry debtors, after deducting all bad and doubtful debts ...	16,373	7	7			
Goods on sale or return	3,473	16	3			
Bills receivable	1,195	19	11			
				21,043	3	9
By CASH at bankers and in hand ...				4,232	12	1
By SHARES in subsidiary companies (*See Provision, per contra*) ...				99,200	0	0
By BALANCE of profit and loss account, No. 1	179,949	15	6			
By BALANCE of profit and loss account, No. 2	25,166	7	8			
				205,116	3	2
				£458,865	0	1

The corporation have a claim to 20 per cent., to the extent of £20,000, of any profits made by Mr. Lane-Fox in respect of the sale or working of his electrical patents.

The corporation have also a claim to one-third of the profits made under the Brush patents for France.

Certificates of shares in subsidiary companies to the nominal amount of £38,500 have not yet been received.

PROFIT AND LOSS ACCOUNT (No. 1) 31st DECEMBER, 1883.

Dr.	£ s. d.	£ s. d.
To Liquidation of accounts with Mr. St. George Lane-Fox, including £14,000 in shares of the International Electric Light Co. transferred to him		51,632 10 0
„ Relinquishment of shares in the Scottish Electric Light Co., less cash and shares received in respect of the corporation's claim as preferential shareholders	11,362 10 0	
„ Relinquishment of shares in the Dublin Electric Light Co. ...	9,000 0 0	
		20,362 10 0
„ Re-purchase of Foreign patents		1,500 0 0
„ Liquidation of accounts with subsidiary companies and others, bad debts written off, and provision for doubtful debts and other contingencies .		31,069 19 1
„ Amount written off book value of stocks		16,058 3 7
„ Provision for shares still held in subsidiary companies... ...		99,200 0 0
„ Proposed further reduction of stocks		47,190 1 3
„ Proposed reduction of patent account		22,275 4 7
		£289,288 8 6

Cr.	£ s. d.
By balance of profit and loss account, 1882 (covering the sum of £50,000, then taken as payable by Mr. St. George Lane-Fox, part of the amount written off on the other side	109,338 13 0
„ Balance	179,949 15 6
	£289,288 8 6

PROFIT AND LOSS ACCOUNT (No. 2) FOR THE YEAR ENDED DECEMBER 31st, 1883.

Dr.	£ s. d.	£ s. d.
To GENERAL CHARGES, viz:—		
Directors' fees, covering the period from 1st July, 1882, to 31st December, 1883	941 1 11	
Salaries	6,308 17 5	
*Law charges	3,794 17 1	
Rent	1,661 16 11	
Insurance	224 11 3	
Rates and taxes	546 3 8	
Gas and water	518 15 2	
Postage and telegrams	102 15 7	
Stationery, printing, &c.	947 9 11	
Travelling and other expenses, and petty disbursements	1,833 2 2	
Carriage and freight	1,010 3 2	
Fuel	2,336 18 0	
Probationary and public installations	642 9 0	
Experimental work	264 11 6	
†Discounts	4,798 5 5	
Interest	601 3 11	
		26,533 2 1
To 10 per cent. depreciation of plant, buildings, &c.		6,342 11 1
		£32,875 13 2

* Law charges include retainers to scientific witnesses' notaries' and Parliamentary and other agents' charges, printing, stamps, translations, shorthand writers' notes, and other disbursements.

† This item arises from the system of bookkeeping during the first half of the year, and consists of discounts allowed to subsidiary companies under their licences.

Cr.	£ s. d.
By Manufacturing account	7,709 5 6
„ Balance	25,166 7 8
	£32,875 13 2

The third ordinary general meeting of the Anglo-American Brush Electric Light Corporation, Limited, will be held at the Cannon Street Hotel, London, E.C., on Wednesday, the 6th day of February, 1884, at three o'clock in the afternoon, for the purposes of receiving the report of the directors, and accounts for the year 1883, and of transacting the ordinary business of the corporation.

Immediately after the ordinary business is transacted the subjoined resolution will be proposed as special business:—

"That the capital of the corporation, which now consists of £800,000, divided into 80,000 shares of £10 each, of which 13,701 shares have been issued, and are fully paid, and 26,999 shares have been issued and have £8 per share paid, or called up thereon, be reduced to £400,000, divided into 80,000 shares of £5 each, and that such reduction be effected by cancelling paid-up capital which has been lost or is unrepresented by available assets, to the extent of £5 per share, upon each of the 40,700 shares which have been issued, and by reducing the nominal amount of all the unissued shares from £10 to £5."

Should the resolution be passed, either with or without modification, by the required majority, it will be submitted for confirmation, as a special resolution, to an extraordinary meeting, which will be subsequently convened.

The Jablochkoff Electric Light and Power Company, Limited.

IN a circular of January 24th, the Secretary, Mr. Francis R. Reeves, says:—"To the Shareholders,—I am instructed by my directors to forward you the accompanying notice of a special meeting, convened for the purpose of passing resolutions for the voluntary liquidation of the company.

"Since the meeting held on the 24th October last, every effort has been made by the directors to carry on the business, but, in the face of hostile petitions for liquidation, and without support from the shareholders, it has been found impossible to do this without entirely reconstructing the company.

"It is, therefore, proposed to submit to the meeting a scheme for the formation of a new company, to purchase and work the business of the present company. The terms of the arrangement will, it is believed, be such as will commend themselves to the approval of the members.

"There are petitions now down for hearing for the compulsory winding-up of the company, and it need scarcely be pointed out that the value of the property consists in its being kept as a going concern; consequently, if the company is stopped and a forced sale be effected, the assets will be so greatly depreciated that the shareholders will probably lose everything.

"There appears no alternative, therefore, but to adopt and pass the resolutions in the notice herewith, and I am to ask you to fill up and return me, on or before Monday, the 28th inst., the accompanying form of proxy, in case you should be unable to attend."

The resolutions referred to, are as follows:—

"1. That this company be wound up voluntarily.

"2. That William Augustine Spain, of 76, Coleman-street, London, chartered accountant, be and is hereby appointed liquidator of the company.

"3. That a general authority be and is hereby conferred on the said liquidator to transfer the business and property of this company to a proposed new company when incorporated, and to be named the Jablochkoff and General Electric Company, Limited, or such other name as shall be decided upon, and to receive in compensation for such transfer, shares or other like interests in the said company, as contemplated by the 161st Section of the Companies' Act, 1862. And for that purpose to enter into an agreement with the said new company for the sale to that company of this company's business and property upon the terms of the draft agreement in that behalf to be submitted to the meeting."

Anglo-American Telegraph Company, Limited.

AT a meeting of the board of directors of the Anglo-American Telegraph Company Limited, held on the 25th ult., it was resolved (after placing £37,500 to the credit of the renewal fund for the quarter ending 31st December, 1883), to recommend to the proprietors at the next half-yearly general meeting of the company, to be held on the 8th February next, the declaration of the following dividends, all free of income tax.

1. A balance dividend of 20s. per cent. upon the ordinary consolidated stock for the year ending 31st December, 1883.

2. A balance dividend of 30s. per cent. upon the preferred stock for the year ending 31st December, 1883.

3. A first and final dividend of 10s. per cent. upon the deferred stock for the year ending 31st December, 1883, all payable on 9th February next.

After paying the foregoing dividends, there will be a balance of about £600 to be carried forward to the next account. The above dividends, together with those already paid, will amount to 3¼ per cent. on the ordinary consolidated stock, 6 per cent. on the preferred stock, and ½ per cent. on the deferred stock, for the year 1883.

The register of transfers will be closed from 25th January to the 8th February, both days inclusive.

Swan United Electric Light Company, Limited.

AN extraordinary general meeting of the shareholders of this company was held at the Guildhall Tavern, on Tuesday, Mr. J. S. Forbes presiding. The meeting was called to approve of the bill which is to be introduced into Parliament in the ensuing Session.

The Chairman moved, "That the bill which is proposed to be introduced into Parliament in the ensuing session, intituled 'A bill to transfer to the Edison and Swan United Electric Light Company (Limited), certain rights, powers, and obligations of the Edison Electric Light Company (Limited), and of the Swan United Electric Light Company (Limited), and for other purposes,' is approved, subject to such additions, alterations, and variations, as Parliament may think fit to make therein."

Mr. Stevenson, M.P., seconded the motion, which was carried unanimously.

A vote of thanks to the chairman closed the proceedings.

London Platino-Brazilian Telegraph.—River Plate and Brazil Telegraph Seven per cent. Debentures.—Debentures falling due on the 1st of March next will be paid off on and after that date by Messrs. Glyn, Mills, Currie & Co., 67, Lombard Street, E.C. Holders desirous of exchanging them for the 6 per cent. debentures, about to be issued by the London Platino-Brazilian Telegraph Company, can do so on application to the secretary, 66, Old Broad Street, E.C., not later than the 1st of February.

Western Union Telegraph Six per cent. Sterling Loan.—The numbers are published of seven bonds of £200 each, and seven bonds of £100 each, amounting together to £2,100, drawn in New York on the 5th January for repayment on the 1st of March next, at the office of Messrs. Morton, Rose & Co, Bartholomew Lane, E.C.

The Cuba Submarine Telegraph Company, Limited.—The directors, after providing for the dividend on the preference shares, recommend a dividend on the ordinary shares at the rate of 7 per cent. per annum, free of income-tax, leaving £594 to be carried forward.

Edison and Swan United Electric Light Company, Limited.—On and after February 1st, the only London office of this company will be at 57, Holborn Viaduct. The Coleman Street office will be discontinued after that date.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations, Jan. 30.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	8	¾ - 1¼	
		Do. Do.	10	3 - 4	
30,000	5	Australasian E. L., Power & Storage Co.	3	..	
24,900	10	British Insulite Co., Ld., "A" Shares.	5	1 - 2	
30,000	5	Brush Elec. Lt. & Power Co. (Scotland)	2½	..	
25,000	5	Gt. Western Electric Light & Power Co.	2½	¼ - ⅜	
24,980	5	Hammond Elec. Lt, & Power Sply. Co.	5	1¼ - 1½	
40,000	5	Indian & Ori. Electl. Storage Wks. Co.	2	..	
250,000	1	Maxim-Weston Elec. Lt. & Power Co.	1	¼ - ⅜	
100,000	5	Metrop. Brush Electric Lt. & Power Co.	3	..	
40,000	5	Pilsen-Joel & Gen. Elec. Lt. Co.	2½	..	
20,000	5	S. African Brush Elec. Lt. & Power Co.	2½	..	
100,000	5	Swan United Electric Light Co., Ld.	2½	⅜ - ½	
		TELEGRAPHS.			
1,892,480*l.*	Stk.	Anglo-American, Limited	100	38 - 39	38¼, ⅜, ½
2,553,760*l.*	Stk.	Do. Pref. } Def. receiving } div. until	100	67 - 68	68, ¼
2,553,760*l.*	Stk.	Do. Def. } 6 p. c. paid to Pref.	100	10 - 11	10¾, ¾, ½, ¾
130,000	10	Brazilian Submarine, Limited	10	9⅞ - 10¼	10 1/16
16,000	10	Cuba, Limited	10	10½ - 11½	
6,000	10	Do. 10 per cent. Preference	10	17½ - 18½	
13,000	10	Direct Spanish, Limited	9	4½ - 5	
6,000	10	Do. 10 per cent. Preference	10	15 - 16	15
65,000	20	Direct United States Cable, Ld., 1877	20	9¾ - 9¾	10
100,000*l.*	100	Do. 6 per cent. Deb., repayable 1884	100	100 -103	
380,000	10	Eastern, Limited	10	10¾ - 11	10¾, ⅞, 15/16
70,000	10	Do. 6 per cent. Preference	10	13 - 13½	
232,000*l.*	100	Do. 6 do. Debs., repayable Oct. 1883	100	..	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101-104	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	104-108	
230,000	10	Eastern Exten., Australasia & China, L.	10	11 - 11¼	11¼, 1/16, ¼
320,000*l.*	100	Do. 6 p. c. Debs., repayable Feb. 1891	100	110- 113	
500,000*l.*	100	Do. 5 p. c. (Aus. Gov. Sub.) Deb. 1900	100	102- 105	
140,000*l.*	100	Do. do. reg., repayable 1900.	100	102- 105	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	102- 105	104
550,000*l.*	100	{ Eastern & South African, Ld., 5 p. c. } { Mort. Deb. Rg. redeemable 1 Jan. 1900 }	100	102- 105	
	100	Do. do. do. To Bearer.	100	102 -105	
22,050	10	German Union Telegraph & Trust, Ld.	10	10 - 10¼	
250,000	10	Globe Telegraph & Trust, Ld.	10	6⅜ - 6⅝	6¼, 3/16
250,000	10	Do. 6 per cent. Preference	10	12¼ - 12½	12½, ⅜
150,000	10	Great Northern	10	13¾ - 13¾	13¾
100,000*l.*	100	Do. 5 per cent. Debentures	100	101 -104	
300,000*l.*	100	Do. 5 per cent. Debentures	100	103 -106	
81,200	10	India-Rubber, Gutta-Percha, & Tel. Wks.	10	29 - 30	
100,000	100	Do. 6 per cent. Debs., 1886	100	102 -105	
18,000	25	Indo-European, Limited	25	31½ - 32½	
40,000	10	London Platino-Brazilian, Limited	10	3⅞ - 4¼	
12,000	10	Mediterranean Extension, Limited	10	1⅞ - 1¾	
3,200	10	Do. 8 per cent. Preference	10	2 - 4	
10,000	8	Reuter's, Limited	8	8½ - 9½	
338,225*l.*	Stk.	Submarine	100	209 -210	209, 5
75,000	1	Do. Scrip	1	1⅝ - 2⅛	
4,200	Cert.	Submarine Cables Trust	100	102 -105	
37,350	12	Telegraph Construction and Mainten.	12	35½ - 36½	36¼
150,000	100	Do. 6 per cent. Bonds, 1884	100	..	
186,750	5	Do. 2nd Bonus Trust Cert.	2½	1⅛ - 1¼	
30,000	10	West Coast of America, Limited	10	5⅝ - 6¼	
130,000*l.*	100	Do. 8 per cent. Debs.	100	107 -110	
45,791	15	Western and Brazilian, Limited	15	5⅜ - 5⅝	5⅜, ⅛, 7/16
24,119	7½	Do. Preferred	7½	4¾ - 5	
24,119	7½	Do. Deferred	7½	⅛ - 1¼	
200,000*l.*	100	Do. 6 p. c. Debs. "A" 1910	100	105 -108	
250,000*l.*	100	Do. 6 p. c. Mort. Deb. B. '80, red. Feb. 1910	100	99 -100	
1,500	$1,000	Western Union 7 p. c. 1 Mort. (Bg.) Bds.	$1,000	122 -126	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	103 -107	
88,321	10	West India and Panama, Limited	10	⅛ - 1¼	1¼
34,563	10	Do. 6 per cent. 1st Preference	10	7 - 7½	
4,669	10	Do. 6 do. 2nd do.	10	5 - 5½	
		TELEPHONES.			
224,850	1	Con. Tele. & Mainten., L., Nos. to 154,165	1	⅛ - ⅜	
225,000	1	Oriental Tele. Co., Nos. 80,001 to 300,000	¼	⅛ - ⅜	
100,000	5	United Telephone Co.	5	7¼ - 7½	7⅜, ½, ¼
20,000	5	Do. New, issued 2 p.m.	2	..	

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending January 25th, 1884, were £2,503, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the week ended the 25th inst., amounted to £3,205.

NEW PATENTS—1884.

1523. "Apparatus to be operated by electricity for producing mechanical effects." J. J. EBEL. Dated January 16.

1548. "Incandescent electric lamps." J. G. LORRAIN. Dated January 16.

1560. "Apparatus for measuring electricity." L. B. MILLER. Dated January 16.

1584. "Magneto or dynamo-electric machines." J. RILEY. Dated January 17.

1603. "Sounding at sea by electricity." W. BALCH. Dated January 17.

1605. "Electric brake for trains, tramcars, or other vehicles." B. F. HOWARD. Dated January 17.

1633. "Apparatus for electrically controlling railway signals.' C. HODGSON. Dated January 17.

1638. "Elements for electric batteries." S. J. COXETER, H. NEHMER. Dated January 17.

1645. "Electric current generators for the production of light, and for other purposes." J. D. GIBBS. Dated January 17.

1647. "Secondary batteries or electrical accumulators." T. J. JONES. Dated January 17.

1674. "Electric lighting." J. P. HALL. Dated January 18.

1692. "Galvanometers." C. D. ABEL. (Communicated by E. Bousser.) Dated January 18. *Complete.*

1708. "Separating magnetic from other substances." G. SONNENTHAL. (Communicated by H. Lamprecht.) Dated January 18.

1709. "Accumulators or secondary batteries." E. P. ALEXANDER. (Commuuicated by J. L. Morey.) Dated January 18.

1721. "Protectors for the insulators of aerial telegraph wires." B. PELL. Dated January 18.

1752. "Utilization and application of virgin coal gas, or carburetted hydrogen, for producing or generating electric currents for the supply of electric light, motive power, and other purposes for which electricity can be applied. A. SHIPPEY. Dated January 19.

1786. "Microphone transmitters for telephonic purposes." W. R. LAKE. Dated January 19.

1789. "Dynamo electrical machines." M. H. HURRELL. Dated January 19.

1790. "Electric arc lamps." M. H. HURRELL. Dated January 19.

1797. "Electric bell furniture." F. KING, W. P. MENDHAM. Dated January 21.

1799. "Compound self-sustaining filament for incandescent lamps." J. G. W. ALLDRIDGE. Dated January 21.

1848. "Electrical signalling and indicating apparatus." G. PORTER. Dated January 21.

1868. "Aerial navigation by means of an electric aerial surveying car." F. BUCHANAN. Dated January 22.

1887. "Fittings of magnetic compasses." W. J. SIMPSON. Dated January 22.

1894. "Dynamo-electric machines." W. ROSS. Dated January 22.

2006. "Dynamo-electric machines." W. A. CARLYLE. Dated January 24.

2036. "Electric alarm attachments for clocks and similar purposes." G. MOORE. Dated January 24.

2041. "Dynamo-electric and electromotive machines." E. C. BRIGHT. Dated January 24. (*Complete*).

2047. "Improved forms of incandescent electric lamps and method of making same." A. THOMPSON, L. R. W. BISHOP. Dated January 24.

2059. "Arc lamps." J. BROCKIE. Dated January 24.

2067. "Secondary batteries." T. J. JONES. Dated January 24.

2073. "Primary and secondary batteries." A. TRIBE. Dated January 24.

2078. "Relay apparatus for electric telegraphs C. D. ABEL. (Communicated by J. Kolzer.) Dated Jannary 24.

2120. "Voltaic battery." D. T. PIOT, A. LEVY. Dated January 25.

2148. "Construction of firing batteries and voltaic elements." J. MATHIESON. Dated January 25.

2185. "Depolarizing secondary batteries." A. C. HENDERSON. (Communicated by C. Philippart.) Dated January 26.

2196. "Generating and storing electricity by means of the action of permanganates on metals." W. FOX. Dated January 26.

2201. "Joint for electric conducting wires." H. J. HADDAN. (Communicated by J. Nanne.) Dated January 26.

2206. "Dynamo-electric machines." W. FAIRWEATHER. Dated January 26.

2211. "Means and apparatus for applying the electric light to cameras, and to other analogous purposes." A. F. LINK. (Communicated by M. Bauer.) Dated January 26.

2212. "Apparatus for breaking electric circuits." H. H. LEIGH. (Communicated by J. L. Huber.) Dated January 26.

2216. "Electric lamp with voltaic arc and solenoids. G. A. TABOURIN. Dated January 26.

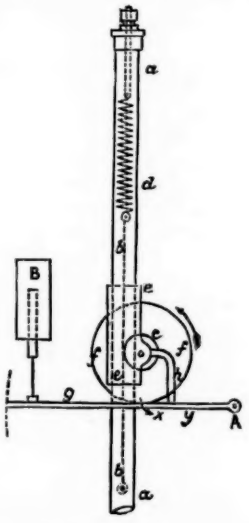
2234. "Excitants for galvanic batteries." J. J. LUNDY, W. F. BOTTOMLEY. Dated January 26.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1883.

1857. "Electric telegraphs." A. A. FAVARGER. Dated April 12. 10d. The whole of the letters or marks which it is intended to employ and transmit by telegraph (say, for example, the twenty-six letters of the alphabet, but stenographic or other conventional characters may be employed,) are arranged in the form of a monogram, and type are prepared in accordance with this monogram. The type are arranged, as in a type writer, to print upon a travelling paper. They are so mounted that they can all strike the paper simultaneously, in which case the complete monogram will be printed, or by selecting the suitable type and causing these only to strike the paper, any letter in the monogram can be separately printed. Each type is actuated by a separate electro-magnet, and to print a complete letter several of these magnets will be brought into activity.

2455. "Primary Galvanic Batteries." G. G. André. Dated May 16. 2d. According to this invention the inventor employs a cheap nitrate, such as nitrate of soda or nitrate of potash in combination with a sulphate such as sulphate of copper in one and the same cell, which contains the copper or other negative electrode; the zinc or other positive electrode is contained in a saline (or it might be an acid) solution. The negative electrode with its combined solution is contained in a porous cell or cells which may be placed in the container for the solution surrounding the positive electrode. The porous cell may advantageously be made of brown paper between an outer and inner layer of parchment paper, on a wooden or other suitable framework. *(Provisional only).*

2539. "Arc regulator lamps." R. E. B. CROMPTON and T. CRABB. Dated 22nd May. Relates to that part of the mechanism of arc regulator lamps which controls the approach towards one another of the carbon electrodes. In the fig. the rod, *a*, *a*, takes the form of a tube with a long slot cut on one side of it. Within this tube is stretched a cord, *b*, *b*, geared to the pulley, *c*, by passing once around it. The end is kept tightly stretched by spring, *d*. *e*, *e*, is a sleeve carrying the axis of the pulley through which the tube, *a*, *a*, can slide freely. *f*, *f*, is the farther of two discs mounted on the same spindle as the pulley, *c*. The nearer disc being removed to show the mechanism. *g* is the vibrating lever pivotted at the point, A, its vibrations are controlled by the solenoid or electro-magnetic device, B. *h* is the arm or support bearing on the upper surface of the lever at the point, *y*. The



peripheries of the disc also bear on the upper surface of the lever at the point *x*. The pressure is shown equally distributed between the points, *x* and *y*, and this is the normal position of the lever. When the solenoid allows the free end of the lever, *y*, to descend, and a part of the pressure which before the movement was transmitted to the lever at the point, *x*, to be transferred to the point, *y*, the peripheries of the discs being partially freed from pressure at the point, *x*, will be free to revolve in the direction of the arrow, and allow the rod, *a*, *a*, to descend through the sleeve, *e*, so as to give a feed movement to the carbon. When the carbons have approached sufficiently closely, the controlling solenoid, B, recommences to draw in its core, thus lifting *g*, and transferring the weight to the point, *x*, arrests the movement of the rod through the sleeve.

2550. "Microphones or telephones." P. JENSEN. (Communicated from abroad by Lars Magnus Ericsson, of Stockholm.) Dated May 22. 2d. Consists firstly of an improved microphone, and partly of a complete telephone arrangement, with its receiving instrument and signalling or call appliance, and is principally to be used as a table apparatus. The microphone itself which is fixed to an upright pillar joined to the framework of the apparatus is arranged in the following manner: the funnel or mouthpiece used for speaking into is moveably fastened to a cover so that it can turn therein. The cover is screwed to a shell or chamber. Under the cover the diaphragm is situated which is covered with a band of India rubber round the edge and fastened to one edge of the cover by a screw and two springs, one of which is provided with a a set screw to regulate the pressure of the other spring against the diaphragm. The latter spring forms a conductor from the diaphragm to the cover and shell. There is a plate of carbon in the middle of the diaphragm, against which a small platinum covered button is supported. A thin pin passes down from the button, and the lower end of it is provided with a small piece of carbon. A small platinum-covered anvil is situated under the latter piece of carbon which is pressed up against the button by means of a helical spring, capable of being regulated as to tension by means of a screw. The pin is guided in a socket. The helical spring and the lower part of the anvil carrier are contained within the just named regulating screw, on the upper part of which is mounted an ebonite socket which carries and insulates the guide socket for the aforesaid pin; the screw is also insulated by an ebonite ring from the shell of the microphone. In the foot or frame of the apparatus is placed an induction coil. A conducting wire is connected to the zinc pole of the battery and to earth. A second wire is connected to the carbon pole of the battery in such manner that the whole battery can act through it. A third wire is connected to the carbon in one of the elements of the battery, so that only a part of the battery acts through it. A fourth wire is connected to the line wire. As is usual in telephone arrangements it is only the induction currents from the induction coil which are admitted to the line. The current through the microphone passes along as follows: first from the carbon in one element (a part of the battery only being closed through the microphone) to the third conducting wire through two contact springs (when the receiving or hearing telephone is taken off its staple or crutch these two springs are in contact with each other) thence through the induction coil, the primary wire, along a wire up through the interior of the pillar, to the regulating screw, the helical spring, the anvil, the lower carbon contact, the pin, the platinum contact, the carbon disc, under the diaphragm, through the latter, the adjustable spring, the screw for fixing it, the cover, the shell and then through the metal of the hollow pillar down to the body of the apparatus, which is connected by a spring to the first wire that leads to the zinc pole of the battery. It will thus be observed that the primary current through the microphone must pass through two platinum-carbon contacts whereby the action becomes excellent. By means of the regulating screw the pressure of these contacts may also at any time be adjusted, thus ensuring the efficient working at all times. *(Provisional only).*

2553. "Dynamo-electric machines and electro-motors." T. T. VERNON. Dated May 22. 2d. The object of the invention is to prevent the loss ordinarily arising in the working of dynamo-electric machines and electro-motors, from the dissipation of electric energy into the metal framing of which they are usually constructed, whereby the electromotive force is diverted and a portion of its useful effect wasted. *(Provisional only).*

2563. "Opening doors by means of electricity, &c." G. F. REDFERN. (A communication from André Gautier, of Cannes.) Dated May 22. 6d. Relates to the construction of an automatic apparatus for opening all kinds of doors whether exterior or interior by means of electricity. The current of electricity once being established operates the interior mechanism of the apparatus and opens the door however hard it may be; and when the door after having been opened is released, it is closed by the action of a suitable strong spring.

2573. "Manufacture of porous or spongy plates, applicable for use in secondary batteries, &c." F. T. WILLIAMS and J. C. HOWELL. Dated May 23. 6d. The object of this invention is to produce porous or spongy lead plates, especially applicable for use in secondary batteries or electrical accumulators. When lead or any suitable alloy of lead and other metals is melted and allowed to cool slowly and to crystalize, highly porous plates may be formed by inserting a suitably perforated mould (of the size and pattern required to produce the plates) into the mixture of lead and crystals of lead or alloys of lead and crystals of the same, and allowing the liquid metal to drain through the said mould, the crystal line or granular plate thus formed is levelled by passing a suitable piece of iron or other material over its surface whilst it is still hot, the plate being then allowed to cool in the mould. To the rough edges of the plates the requisite finish may be given either by dipping them for a short time in hot lead or by compression (or by a combination of these methods) or by other suitable means. The plates are then ready for use or they may be passed through rolls or otherwise compressed if so desired.

2570. "Electric arc lamps." P. JOLIN and J. PARSONS. Dated May 23. 8d. Consists, first, in the method of opening or striking the arc; secondly, in means whereby the carbons are fed with steadiness and regularity as the points are consumed in giving light; and, thirdly, in the method of cutting off or shunting the current from any lamp of a series and re-establishing the arc therein. Further improvements relate to devices for holding the carbons and the globes. The opening or striking of the arc is effected by means of a double electro-magnet composed of two hollow electro-magnets wound with coarse wire and having moveable cores, either hollow or solid, attached at their lower ends to a bar of iron which carries a block normally bearing against one side of the upper carbon rod. To this block is hinged a second block, situated at the side of the carbon rod opposite to the first-mentioned block. Attached to the second block is one end of a spring, the other end of which lies in the space caused by slotting the frame of the lamp, or between two stops formed on the frame. When, by the passing of the current through the wires of the double electro-magnet, the cores thereof are caused to rise, the aforesaid spring is brought into contact with one edge of the slot or the upper stop and so causes the carbon rod to be gripped between the two blocks and raised accordingly.

CORRESPONDENCE.

The Theory of Dynamo Machines.

It would be well if your correspondents, in giving the watts developed per lb. of copper in the particular machine they advocate, would give the number of changes of polarity per revolution.

It is hardly probable that the performance of two dynamos, each with its peculiar armature, would give by its action any indication as to their respective merits, as the field and general arrangement, also the weights of iron in the two machines, might vary considerably.

Soho.

The Theory of the Gramme Ring.

It is interesting to note, at the advanced stage of electric lighting which we have reached, the points of discussion apparently no nearer solution than they were years ago, which still engage the attention of electrical engineers. First, it is to be noted that very different ideas are sought to be expressed by the terms efficiency. In the ELECTRICAL REVIEW, of the 19th inst., Mr. Heinrichs seeks to express efficiency in terms of the number of watts produced per lb. of copper on his dynamo, and necessarily claims a high efficiency for a machine which, by the very fact of the large number of watts developed per lb. of copper, is shown to have a low efficiency; the term efficiency being here used in its ordinary sense, to express the ratio between the electrical energy which may be utilized in the lamps, and the whole electrical energy developed by the machines. Taking from *Engineering* the tests referred to by Mr. Heinrichs, we find that the internal resistance of the Heinrich dynamo was 1·83, and that the resistance of the three lamps it supplied current for was 3·72; the efficiency of the dynamo was therefore

$$\frac{3{\cdot}72}{3{\cdot}72 + 1{\cdot}83} = 67 \text{ per cent.}$$

a very low efficiency indeed. It is further stated in that misleading article that the Heinrichs dynamo gives one light for each 5½ lbs. of copper employed in its construction, against one light for every 10 lbs. of copper in the Brush machine. This may be a very convenient way of looking at the out-put of machines; convenient, that is, for all but the unfortunate individual who has at the year's end to pay for the horse-power which has been expended in heating the wire of his dynamo; but the statement acquires a somewhat different value when we remember that the efficiency of the Brush machine is 87·3 per cent. against 67 per cent. for Heinrich's machine. With reference to the output of the "Victoria," we expect from a large machine a greater number of watts per lb. of copper, and also a higher efficiency, but as yet we know very little about the efficiency of the Victoria dynamo, and it would be well if Mr. Mordey, having informed us on one point, would add to our information on this point at an early date.

With the statement made by M. De Wolffers regarding the idle wire on the Gramme machine, I agree. To talk of one part of a coil being idle while another part of the same coil is active, is absurd and very misleading. I have always been in the habit of thinking that the E.M.F. in any dynamo machine with a ring armature is proportional to the number of lines of force passing through the ring at the brushes, and I fail to see how enveloping the ring with a pole-piece can add to the E.M.F. of the machine, unless at the same time the number of turns on the field-magnets is increased, or the machine otherwise modified in such a way as to increase the strength of the magnetic field.

I admit that in flat ring armatures the lines of force enter the ring from both sides; but this does not alter the total number of lines of force entering the ring, nor the number passing through the ring at the brushes, and if the coiling is similar with the same strength of field, the number of lines of force added and subtracted in a revolution remains unaltered, and consequently the E.M.F. is the same as at first. The function of the ring is to strengthen the field, but more particularly to bring all the lines of force inside itself, so that each coil encloses all the lines of force twice during its revolution. If the ring be too light in section, some of the lines of force go straggling through the centre of it, and both the power and the efficiency of the machine are reduced; but it would be interesting if Mr. Mordey would explain how these straggling lines of force, "by cutting a second time the wires of one part of the ring, neutralize on the inner side the effect they would be capable of producing on the outer wires. As a matter of fact, a Gramme machine will work without an iron core at all, although very badly; badly, not because the lines of force cut the coils twice, but *because the maximum number of lines which can be enclosed by a coil is very small, the majority of them going through the centre of the ring.* In many of the machines which have been constructed for the purpose of improving Gramme, the device is worse than useless; for in the case of the Jurgensen and Fein machines, the proximity of the pole-pieces is increased, being brought inside the armature, and consequently the liability for lines of force to run from pole to pole, without traversing the ring armature, is increased.

In conclusion, I would ask Mr. Mordey a question. Supposing we have two machines with the same mass of iron in the magnets, the same section of ring armature, and the same number of turns on magnets and armature, with only this difference—that in the one the greater dimension of the ring lies parallel to the spindle, while in the other it lies perpendicular to the spindle, would one of the machines have a higher E.M.F. than the other? and in the interests of science I would humbly add, in the language of the examination room:—Give reasons for your answers.

E.

Who is the Inventor of the Electric Telegraph?

Mr. W. Phillips asks this question in your impression of last Saturday, *apropos* of the claims lately set up for Mr. Davy, and adds that he has hitherto been under the impression that Messrs. Cooke and Wheatstone, in England, and Professor Morse, in America, were the first inventors of the electric telegraph.

Never was there a greater fallacy. The electric telegraph is not the work of any one man, or of any one age. From the year 1600 onward, philosophers of all nations had been collecting the materials from day to day, and from 1753 onward other philosophers, also of all nations, had been combining these materials in various ways with the view of producing electric telegraphs.

Between the years 1753 and 1837, upwards of forty proposals of this kind are known to have been made, six at least of which were reducible to *practicable* forms,

so that had Cooke and Wheatstone and Morse never been born we should still have to-day our electric telegraphs.

Although, then, Messrs. Cooke, Wheatstone, and Morse cannot properly be called the *first* inventors of the electric telegraph, they deserve, and have received, all credit for having practically introduced it. They have done nothing more, and, be it always remembered, *they claim to have done nothing more.*

But while we remember those who, taking the tide at its flood, have been borne on to fortunes and honours, we ought not to forget the pioneers who showed them the way; of these Mr. Edward Davy is the greatest and the only one now living, at the ripe age of 78! How near he was to success, Mr. Phillips will soon have an opportunity of reading in my *History of Electric Telegraphy*, which Messrs. E. and F. N. Spon have now in the press; or if he reside in town, he can consult the Davy MSS., which are now in the library of the Society of Telegraph-Engineers and Electricians. These will tell him *who* Mr. Davy is, and *why* his claims are now brought forward after the lapse of so many years—nearly half a century.

The story as unfolded in these MSS. is, I have no hesitation in saying, without a parallel in the whole history of scientific discovery.

The honours lately conferred upon Mr. Davy by his fellow-colonists, are within his due, but they are greatly enhanced by the ready and hearty spontaneity which characterised them. The telegraph-engineers of England—aye of the world—owe more than they wot of to the inventor of the "pecker," and I feel sure his claims require only to be known to be appreciated by them. Your insertion of this letter will conduce to this end, and I will therefore be obliged by your giving it a place in your next issue.

J. J. Fahie.

London, *Jan. 28th*, 1884.

Electrical Books.

In your last issue you note that the third edition of "Kempe's Testing" is now in the press. Perhaps it will not be inopportune if you will allow me to venture the suggestion, that Messrs. Spon & Co. might put a little more strength into the binding of this class of books. From their nature they are intended, and have to submit to much handling, and they deserve substantial binding. My own copy of the second edition of "Kempe" came unstitched after a few days' use, and I have heard complaints as to the weak binding from all whom I know to possess copies. "Clark and Sabine," again, is another book very badly bound, and I doubt whether any one possesses a copy which has withstood reasonable wear. If the price will not allow of better binding, I don't think any would object to paying an extra shilling to have something that would effectually preserve the books.

W. C.

Jan. 28th, 1884.

[Our correspondent's suggestion deserves every attention.—EDS. ELEC. REV.]

The Theory of the Gramme and Unipolar Dynamo Machine.

Since silence on my part to M. de Wolffers' reply in your last issue, could be construed by your readers as submission to M. de Wolffers subtile arguments; I beg of you just enough space to make a reply, which I find I cannot do without a short recapitulation of the main points of the controversy.

M. de Wolffers in his letter in your issue of the 12th inst., attacked every one who could not see with him the "absurdity" of considering the wire on the inside of a Gramme ring as useless. He declared certain publications as "fallacious," and in support of his views showed an iron filings diagram, "invented" by him for the purpose of demonstrating the usefulness of the wire on the inside of a Gramme ring. He further stated "knowingly," that other machines (my own included), were not more efficient than the Gramme, wisely omitting reliable figures in support.

Knowing my machine to be superior in all respects to the *Gramme improvement on the Pacinotti invention*, and seeing the absurdity of M. de Wolffers diagram (which Mr. W. M. Mordey took the trouble to explain in your last issue), I thought it sufficient proof of the *uselessness* of the wire on the inside of a Gramme ring, to show to M. de Wolffers, that in my machine, also an improvement on the "Pacinotti," I do not make use at all, of the wire on the inside of the ring armature for the generation of currents, and that this machine gave at least twice as much current with about the same amount of copper wire as used on the "Gramme." I stated the derived figure of 50 watts per lb. of copper wire, merely for the above purpose.

I further challenged M. de Wolffers to expose or explain the "fallacies" of the publication he attacked, since it seemed to me that M. de Wolffers wished to make your readers believe that the conclusions he drew from his diagrams were universally accepted, and I thought his whole object was to advertise the "Gramme" at the cost of every other machine.

In your last issue M. de Wolffers leaves the wire on the inside of the Gramme ring "useless;" but he turns the table, and says about as follows: "I meant the efficiency as regard to the ratio of horse-power used and given out. I have read the tests of your machine, and from these tests I have classed your machine among the machines which are not more efficient than the Gramme."

I regret that I must repeat the words of my last letter, "these assertions show M. de Wolffers' ignorance on the subject," since no tests as to the ratio of horse-power used, and given out by my machine, were ever published (for reasons: my machines are not yet in the market, and I had entered into an agreement, and imprudently accepted a clause, which forced my European patents to idleness until the 1st January, 1884.) M. de Wolffers ought to have asked me with good grace, for figures as to horse-power, and I should have been pleased to give every information in my power.

I shall be glad to hear of any reliable measurements recently taken in this country of the Gramme machine, proving the 93 per cent. efficiency, stating at the same time, the method and apparatus, with which the figures have been obtained. As well known, figures of the efficiency of several machines have been published, from which could be seen at once the impossibility of having got the results otherwise than by fallacious methods."

I am just now arranging to re-take the efficiency of my machine and lamps, particularly as to the horse-power absorbed and given out by my machine, and I shall be glad to forward you the results for the criticism of your readers; but I may at once remind M. de Wolffers that the efficiency of my machine in regard to the ratio of horse-power, "*need not be sensibly above that of the Gramme* before it can be allowed to be more efficient than the latter," since he has not disputed the fact that my machine is superior as regards economy of copper wire used, consequently my machine is much cheaper than the "Gramme," which is in itself a great factor, independent of the superior principle of construction of my machine.

Concluding, and in reply to the last paragraph of M. de Wolffers' letter in your last issue, I beg to remind him of the fable of "The Fox and the Grapes;" trusting at the same time that M. de Wolffers will understand that I cannot further reply to any of his arguments in this matter.

Charles F. Heinrichs.

London, *Jan. 28th* 1884.

Experiments by Eminent American Physicists with Telephones.

I send to you some extracts from affidavits (manuscript copies of which were sent to me) used in a suit for infringement of the Bell Patents, now pending in New Jersey, made by Professors Henry Morton and Alfred W. Mayer, in the latter's laboratory at the Stevens' Institute in Hoboken, New Jersey.

In these experiments, the receiver used was the Hopkins, a telephone constructed after the Mc'Donough or Bell patents, such as is used by the United Company in England. The transmitter, the Hopkins, is thus described :—A tympan of thin metal or mica, having a small button of hard carbon secured to its centre, which is in contact with another piece of carbon, this second piece of carbon is attached to the end of a metallic rod, which is supported by and floats in mercury contained in a long-necked bottle. This current regulator is placed in circuit with a battery and primary wire of an induction coil, the receiver being placed in the secondary wire of the coil.

Extracts.—"Experiments were made with several carbons of various weights, so that the pressure between them varied from one-half a gramme to nearly twenty grammes; yet, in all these cases, it required the addition of two grammes to the upper carbons to produce a perceptible increase in the currrent."

"Now such being the fact in reference to the effect of pressure between the carbons of this transmitter in varying the strength of the current traversing them, it follows that in the secondary circuit there is no current during the time that the pressure between the carbons of the transmitter is coming up to an increase of two grammes; for during this portion of the time of the momentary contact of the carbons, the current in the primary coil of the inductorium is a constant one, and therefore it cannot, as all physicists know, cause any current in the secondary coil of the inductorium. Hence there are breaks in the current in the line and receiver."

"These instruments produce articulate speech with great distinctness, not by means of undulations of electricity conforming to air waves, but by single and simple impulses of electricity."

"When a primary current is so varied as to produce a certain number of fluctuations in a given time, a secondary current produced thereby will fluctuate in a very different manner, and among other variations will show twice as many fluctuations in the same time, or, if these fluctuations cause vibrations, will produce a note which is an *octave higher* than that corresponding with the fluctuations of the primary circuit."

"When a tuning-fork was sounded before this transmitter, properly adjusted for the transmission of speech, and so connected with a battery and induction coil that the battery current, controlled by the transmitter, passes through the primary circuit of the induction coil, while the secondary circuit of the same coil was connected with the line wire and the telephone receiver. Under the above conditions, the sound heard at the receiver was not that of the fork sounded before the transmitter, but was exactly an *octave higher*."

"The experiment was conducted in the following manner by Professor Mayer, in the presence of Professor Morton and Messrs. William C. Hicks and Gustavus J. Wagner, each one of whom made affidavits as above :—

"An U^{1}_{3} fork on a resonant case was carefully sounded with a bow, and it was observed that no trace of its octave U^{1}_{4} could be perceived in the sound emitted, even with the aid of an U^{1}_{4} resonator. Then this fork being sounded as before close to the transmitter connected as above described with an induction coil, with a telephone receiver in the line in the circuit of the secondary wire of the coil, and the sound, U^{1}_{4}, was then clearly recognisable, both directly and by the aid of the same U^{1}_{4} resonator, which had failed entirely to give any response to the sound of the U^{1}_{3} fork."

"If a given resonation resounds, we may be sure that its corresponding note is present, and if it does not resound, that its note is absent."

I forbear to make, at present, further extracts from these affidavits. Those given above show that articulate speech can be transmitted, if not by means of, at all events, *in spite* of, *makes and breaks* of the electrical current, a fact which the Reis transmitters (the lever form and the square box form) long since proved to my entire satisfaction.

The effect of various degrees of pressure on two carbons in loose contact, described by these physicists, seems entirely subversive of the theory of the action of the carbon microphone held by eminent electricians here.

Das Telephon.

January 28th, 1884.

The New Patent Rules.

In response to the inquiry of "A Patentee" in you last issue, a stamp of 2s. 6d. is required on statutory declarations made under the provisions of 5 and 6, William IV., c. 62, under which statute the patent declarations are made. As, however, the new patent declarations do not differ materially from the old ones, which were always accepted without a stamp, I fail to see why any alteration in the practice hitherto followed should now be made, and probably the patent officials have come to the same opinion, as they have just announced that in future declarations made before Commissioners for taking Oaths, in connection with applications for patents, will not be required to bear a 2s. 6d. stamp.

T. J. Handford.

42, Southampton Buildings, W.C.
January 28th.

The United Telephone Company and Parliamentary Powers.

I should like to know what regulations the United Company want Parliament to make? Parliament cannot give the right to place wires over any person's property. Let the United Telephone Company obtain permission from householders or occupiers of houses; secure their wires in a proper manner, obtain permission from local authorities, to cross public avenues, and they have all that Parliament can grant. It is only a question of expense as to using underground wires, and if that company had not paid such an exorbitant price for its patents (some £250,000), it could afford to use underground wires, and supply the public with telephonic facilities at one-half its present charges.

Anti-Monopoly.

Jan. 25th, 1884.

Re Fiske-Mott Insulator.

[With reference to Mr. Fiske's letter in our last issue, in the absence of comparative tests, we still adhere to our opinion with reference to the efficiency of the above insulator. That an unusually high degree of insulation may be obtained by a material which has the power of repelling moisture in a high degree, or at least of preventing its forming a continuous film over the surface of the insulator, we are not prepared to deny; but we must repeat that the result of *practical experience*, in this country at least, has conclusively proved that the notion that a diminished surface of contact improves the insulation is fallacious. We know of one form of insulator, indeed, in which the principal of small surface contact is carried out, and to a much greater extent than in the Fiske-Mott pattern—in fact, the contact in the case we refer to is at one point only, and not at several—but the result has not proved a success; in fact the insulator is at its best but a very indifferent one. Mr. Fiske's statement that "The leakage of ten insulators on a telegraph line is about ten times that of one insulator, *because the area of contact* is about ten times as great" is not a correct one. The leakage is ten times as great because there is ten times the amount of *surface* for the current to leak over. It is, in fact, the whole *surface* of the insulator which determines the value of the insulation, and not the area of contact of the wire. In making our statement, it must be observed that we do not suggest a theory which practice may possibly prove to be correct, but we start from actual known facts, and merely put forward our theory to explain the cause. Our theory may be wrong, but this in no way affects the correctness of the facts.—EDS. ELEC. REV.]